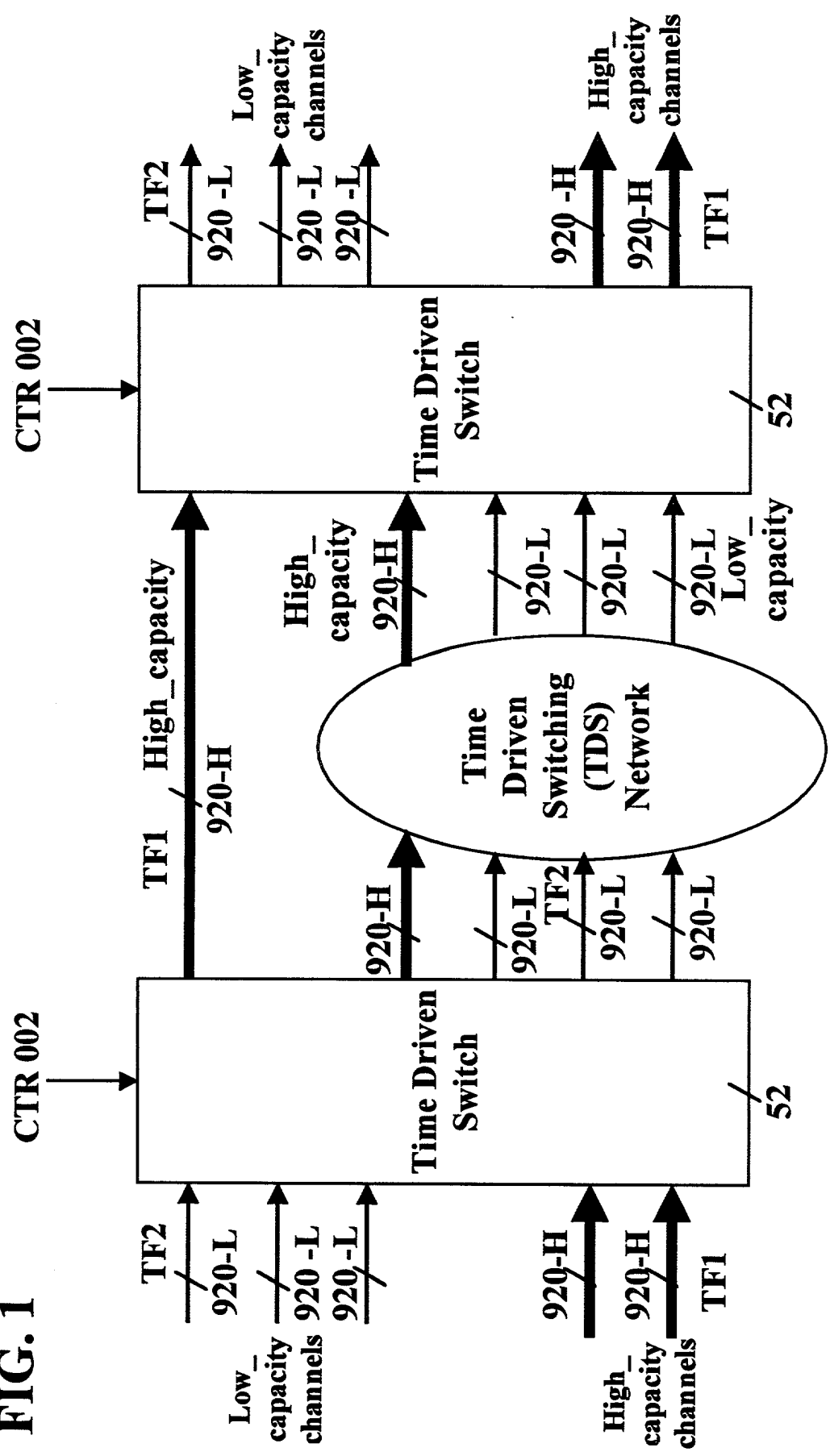


FIG. 1



c = High_capacity/Low_capacity

FIG. 2

Example:

TF1=15.325 microsec - High_capacity = OC-192

TF2 = 125 microsec - Low_capacity = OC-3

$\Rightarrow c = 64 = (OC-192/OC-3)$

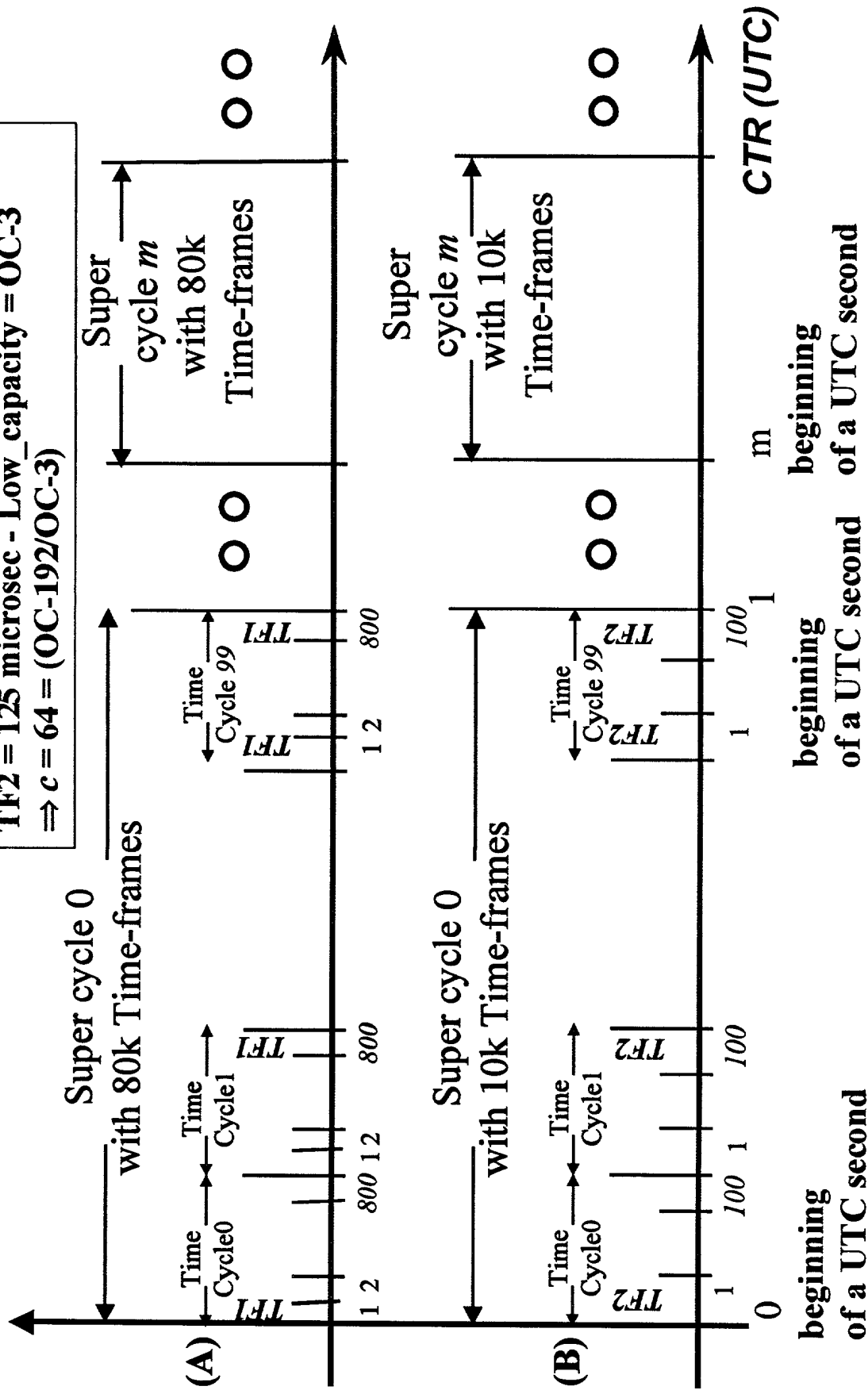


FIG. 3

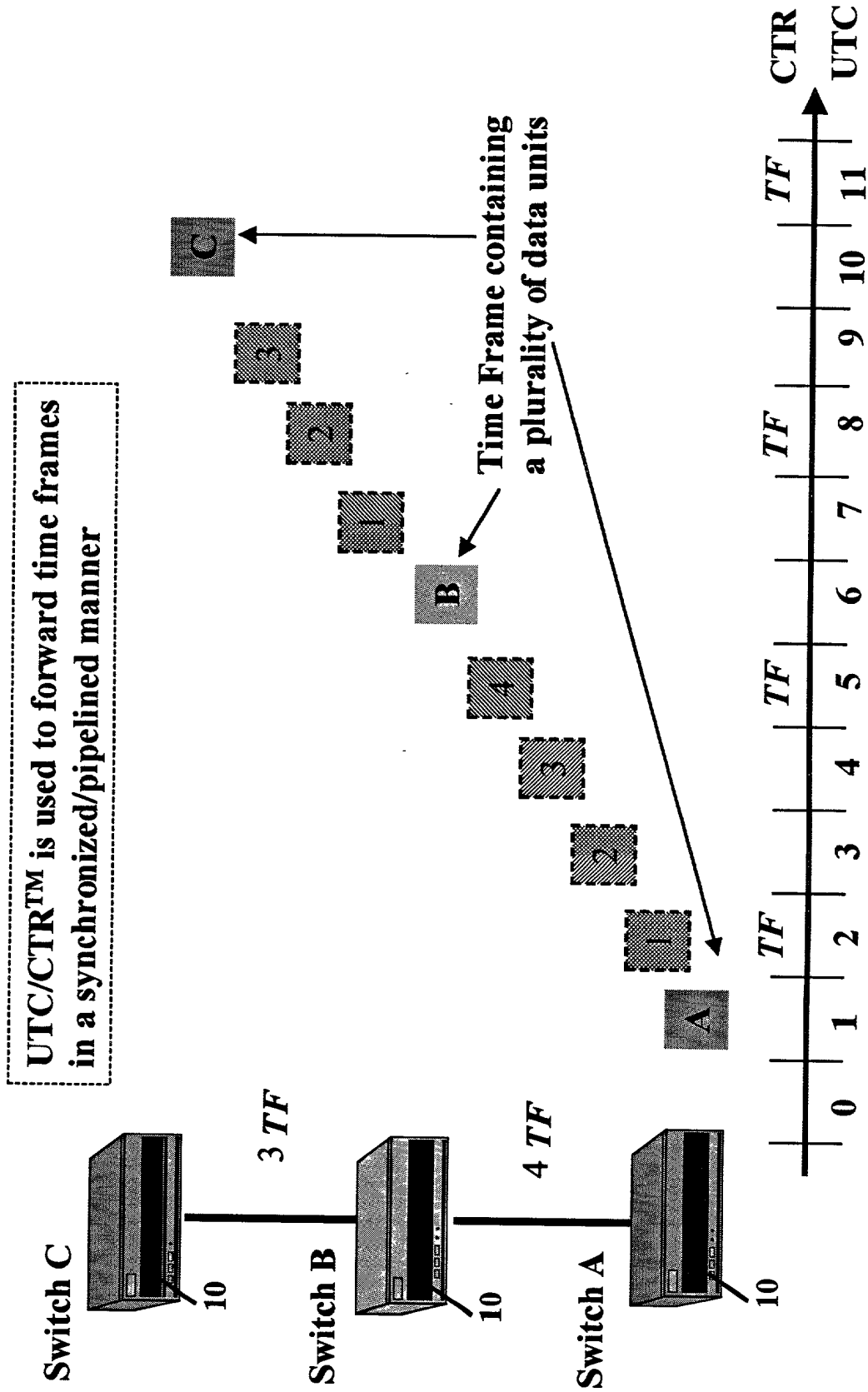


FIG. 4

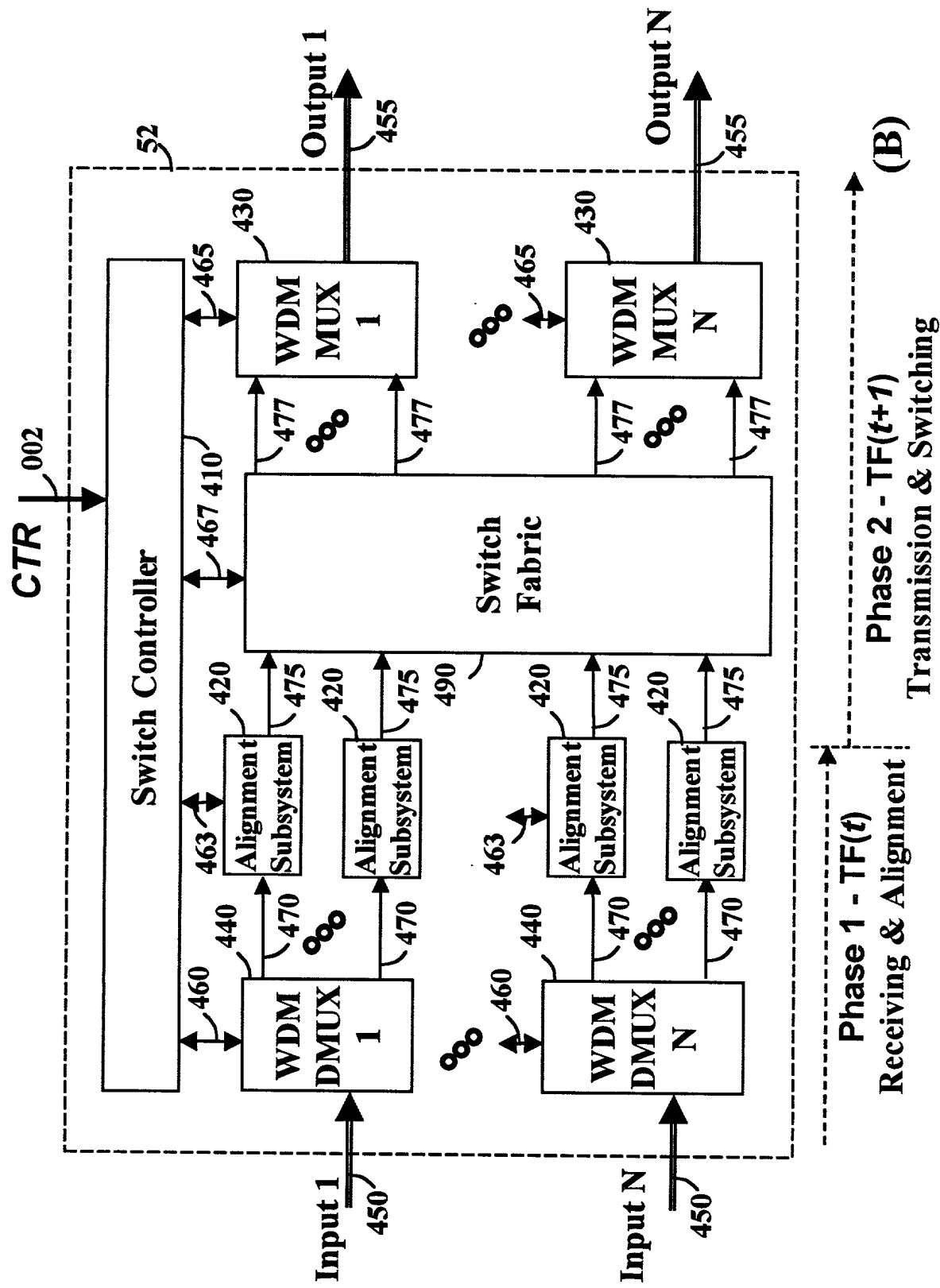


FIG. 5

Two time intervals: $SC1_length \cdot TF1 = 1$ UTC second

- $SC2_length \cdot TF2 = 1$ UTC second
- $TF2 = (SC1_length / SC2_length) \cdot TF1 = k \cdot TF1$, where the time cycles of TF1 and TF2 are aligned with respect to UTC.

For $k = 2$ and $c = 4$ (e.g., High_capacity=OC-192, Low_capacity=OC-48):

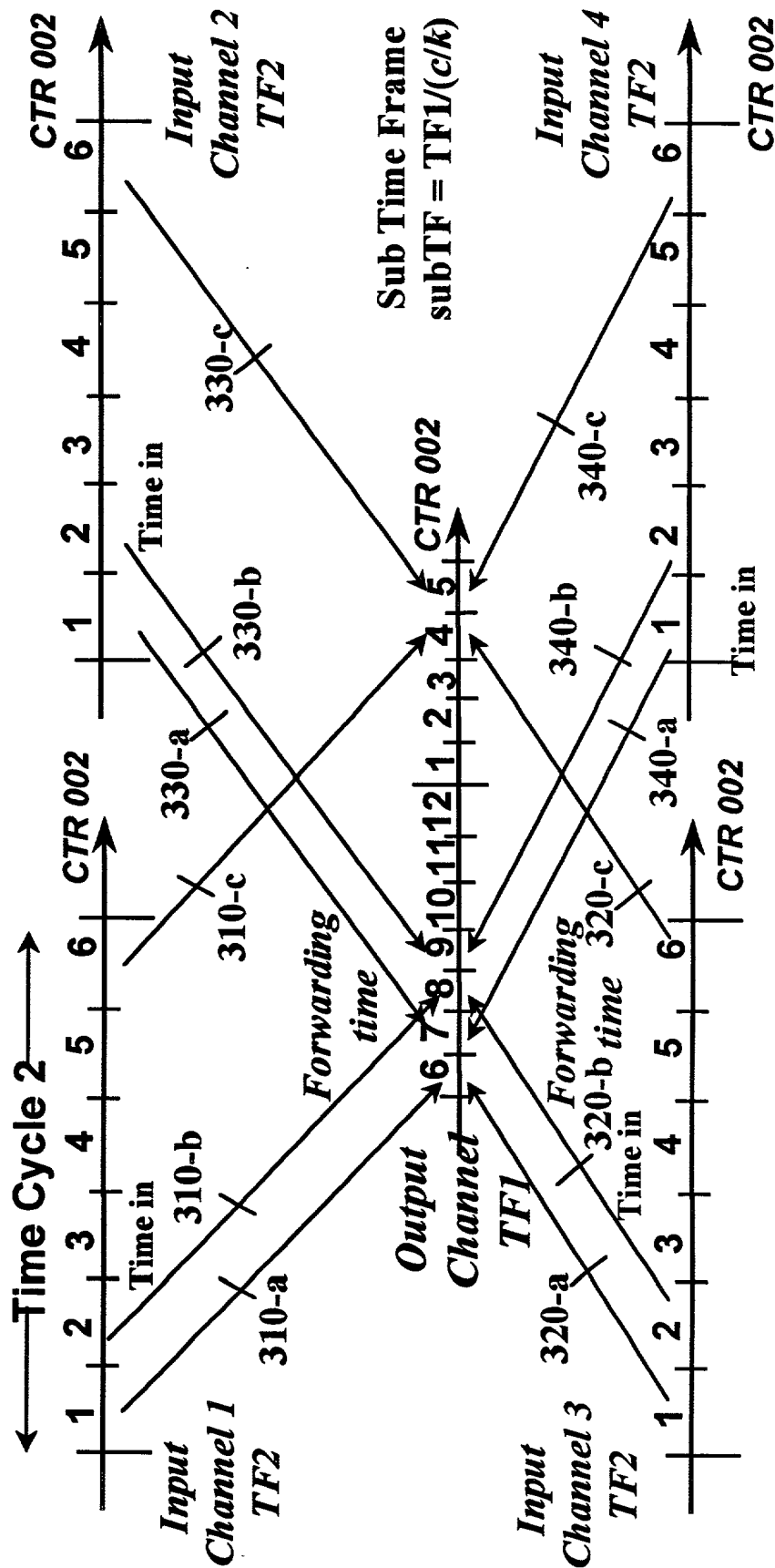


FIG. 6

Two time intervals: $SC1_length \cdot TF1 = 1$ UTC second

- $SC2_length \cdot TF2 = 1$ UTC second
- $TF2 = (SC1_length / SC2_length) \cdot TF1 = k \cdot TF1$, where the time cycles of $TF1$ and $TF2$ are aligned with respect to UTC.

For $k = 2$ and $c = 4$ (e.g., High_capacity=OC-192, Low_capacity=OC-48):

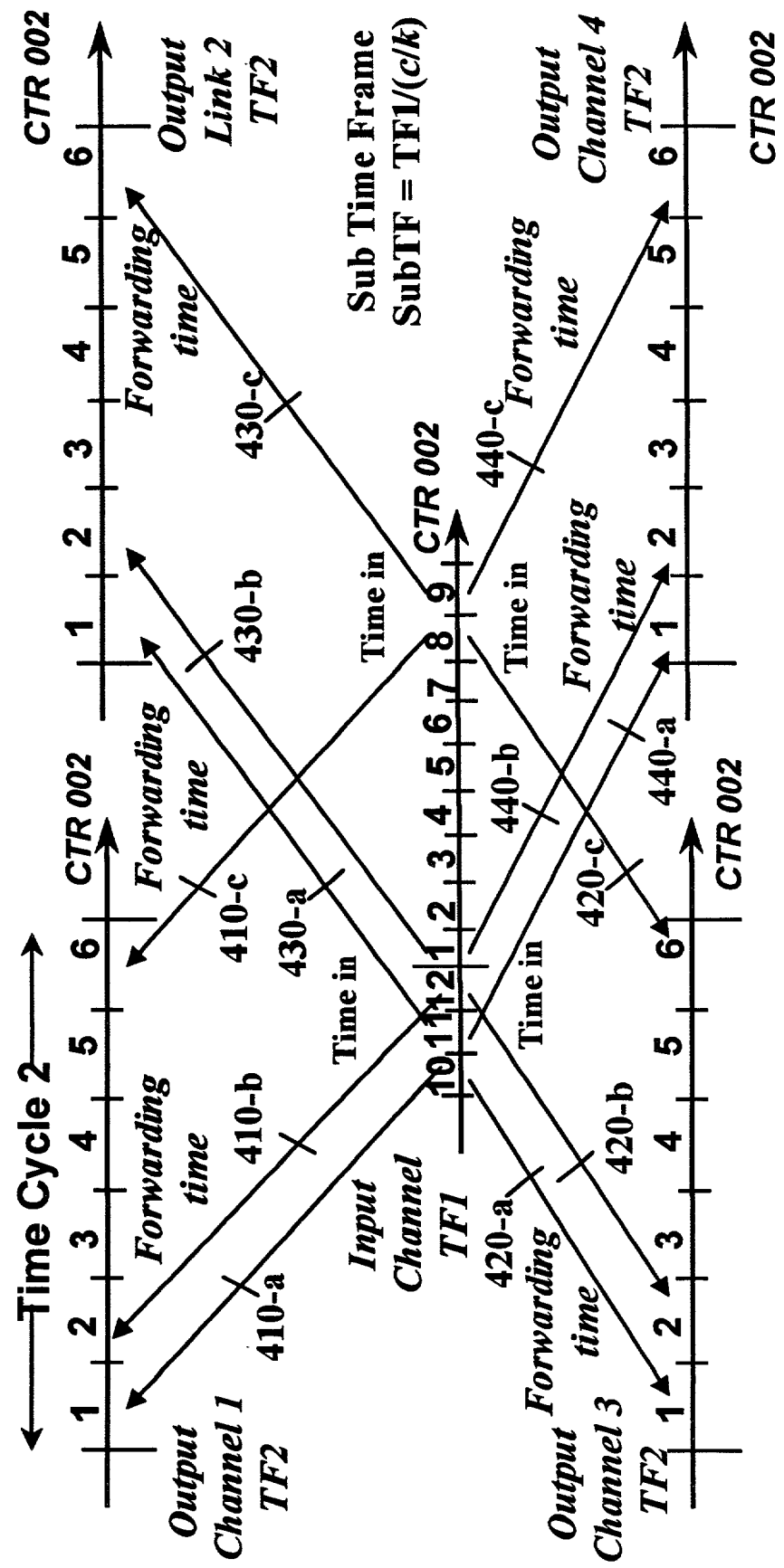


FIG. 7

Two time intervals: $SC1_length \cdot TF1 = 1$ UTC second

- $SC2_length \cdot TF2 = 1$ UTC second

- $TF2 = (SC1_length / SC2_length) \cdot TF1 = k \cdot TF1$, where the time cycles of $TF1$ and $TF2$ are aligned with respect to UTC.

For $k = 2$ and $c = 4$ (e.g., High_capacity=OC-192, Low_capacity=OC-48):

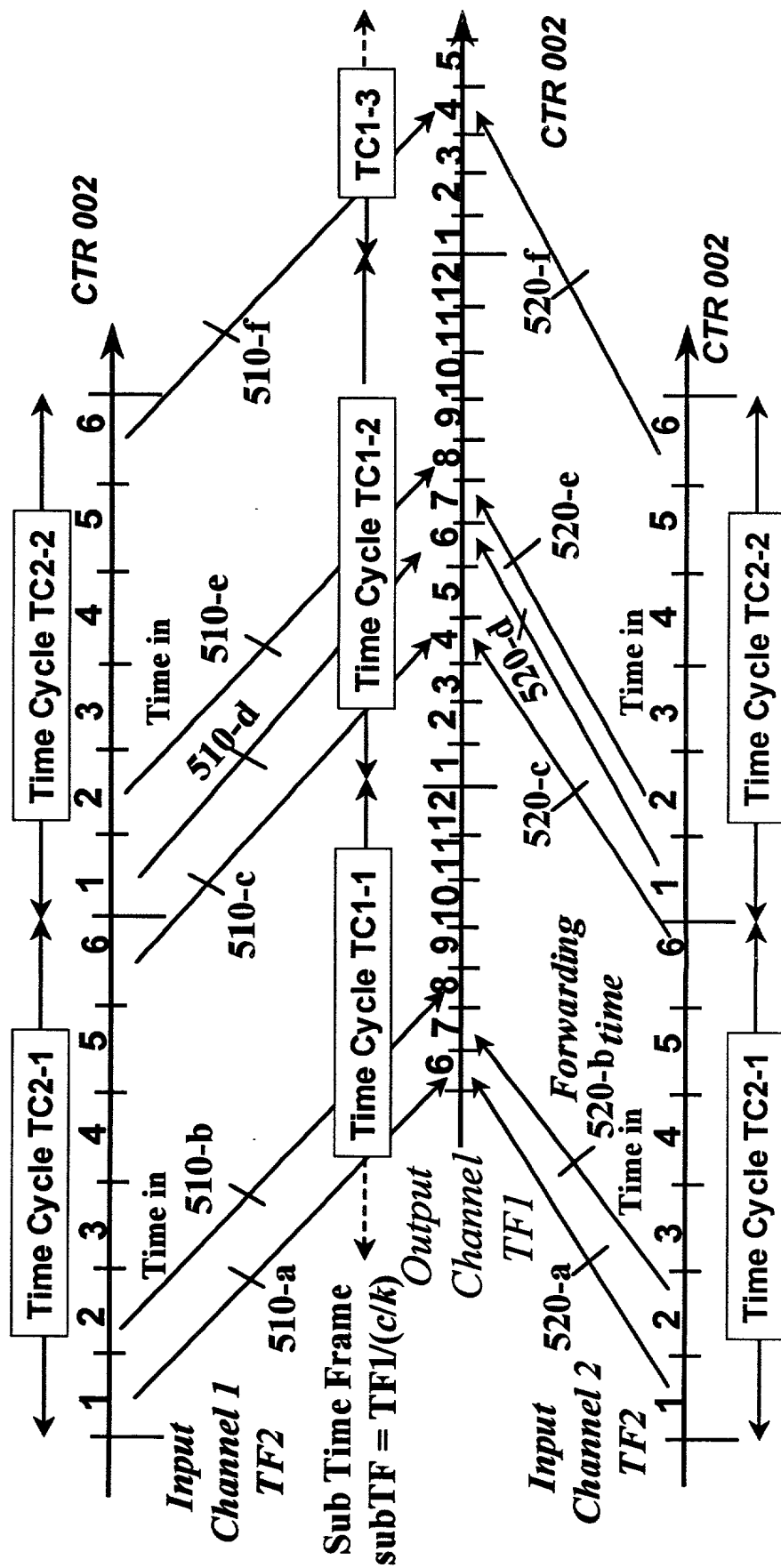


FIG. 8

Two time intervals: $SC1_length \cdot TF1 = 1$ UTC second

- $SC2_length \cdot TF2 = 1$ UTC second

- $TF2 = (SC1_length / SC2_length) \cdot TF1 = k \cdot TF1$, where the time cycles of $TF1$ and $TF2$ are aligned with respect to UTC.

For $k = 2$ and $c = 4$ (e.g., High_capacity=OC-192, Low_capacity=OC-48):

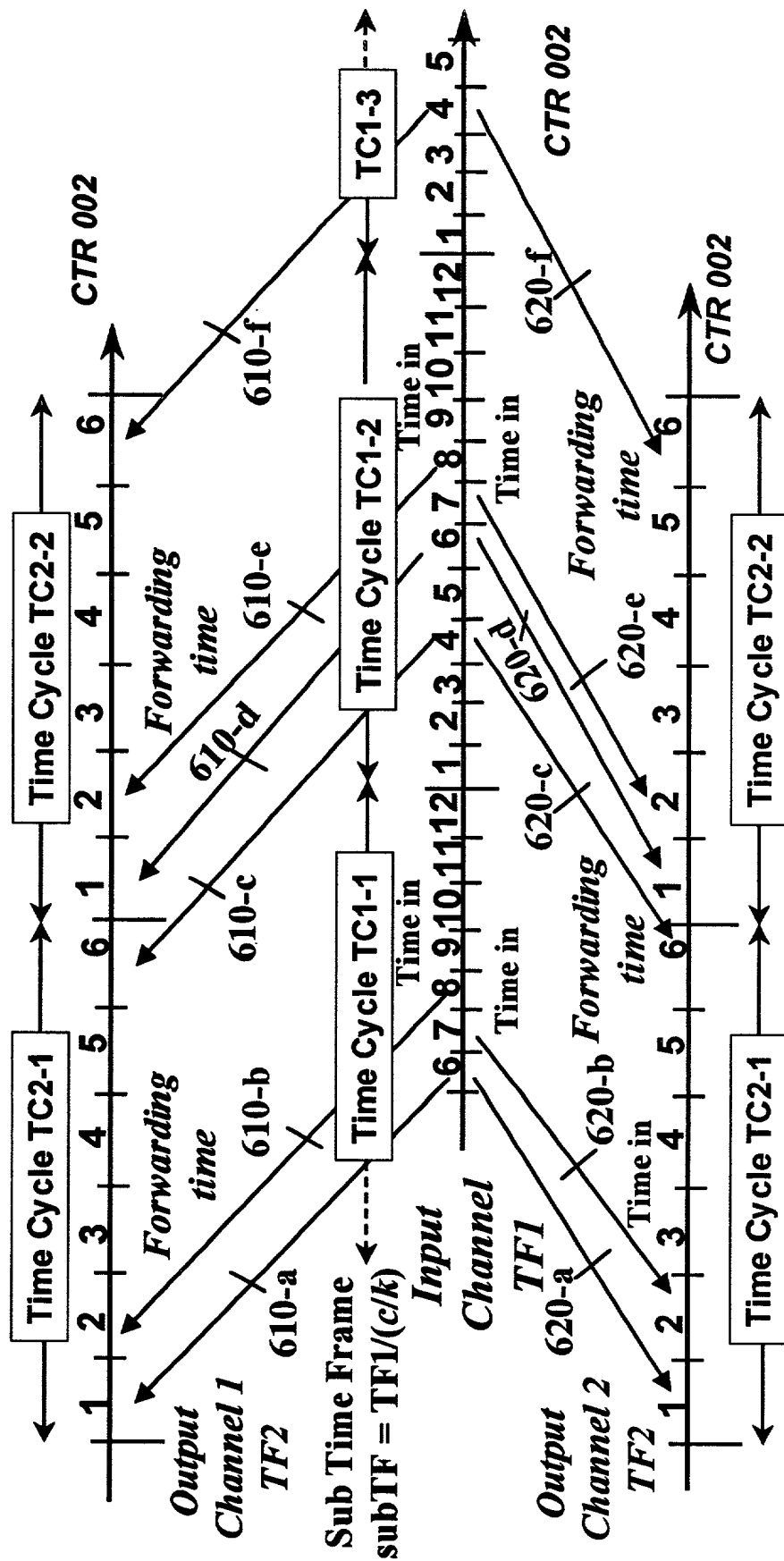


FIG. 9

$c=4$, e.g., OC-192/OC-48
 $k=2$, e.g., 25 microsec/12.5 microsec

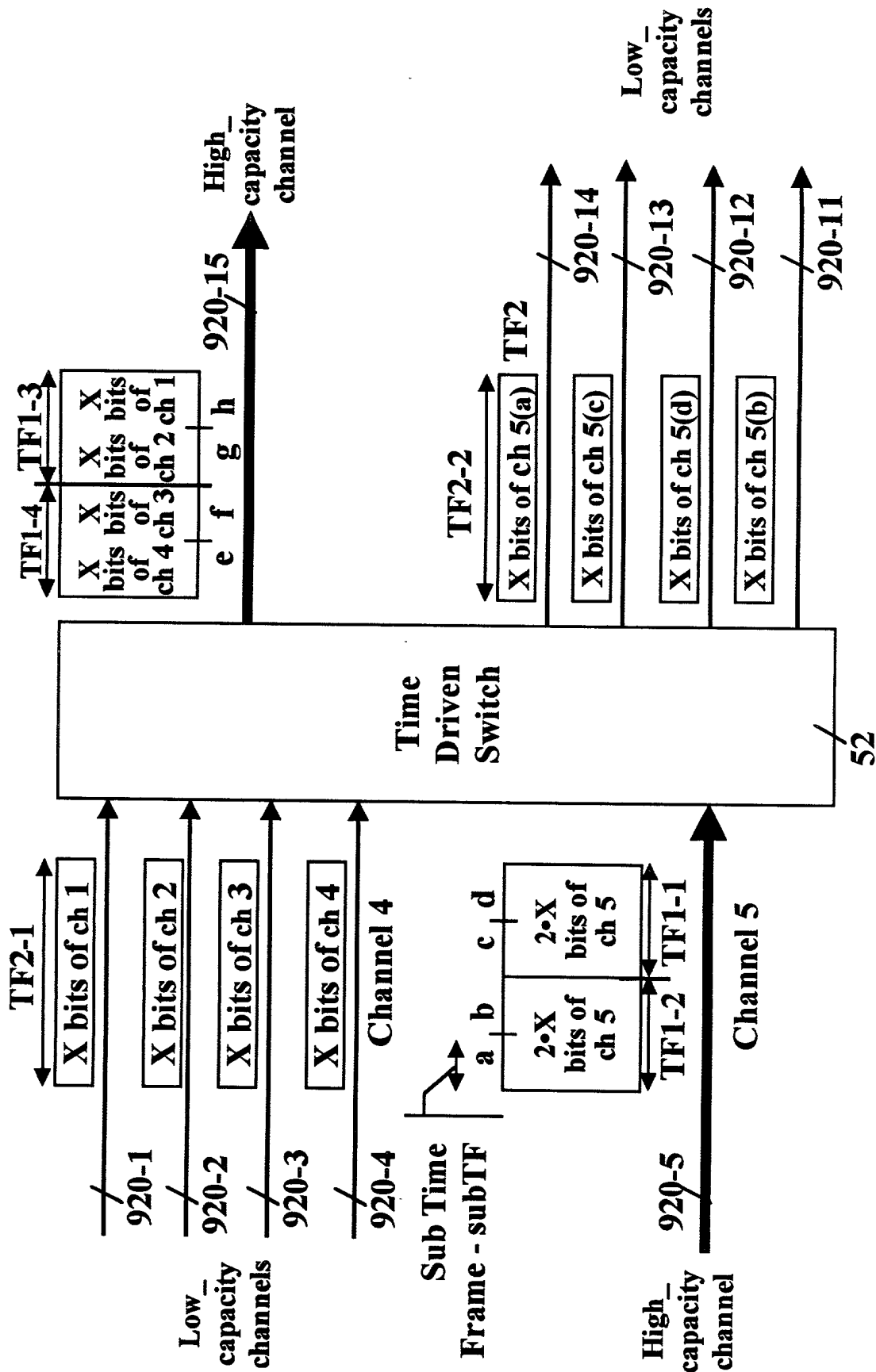


FIG. 10

$c=4$, e.g., OC-192/OC-48
 $k=2$, e.g., 25 microsec/12.5 microsec

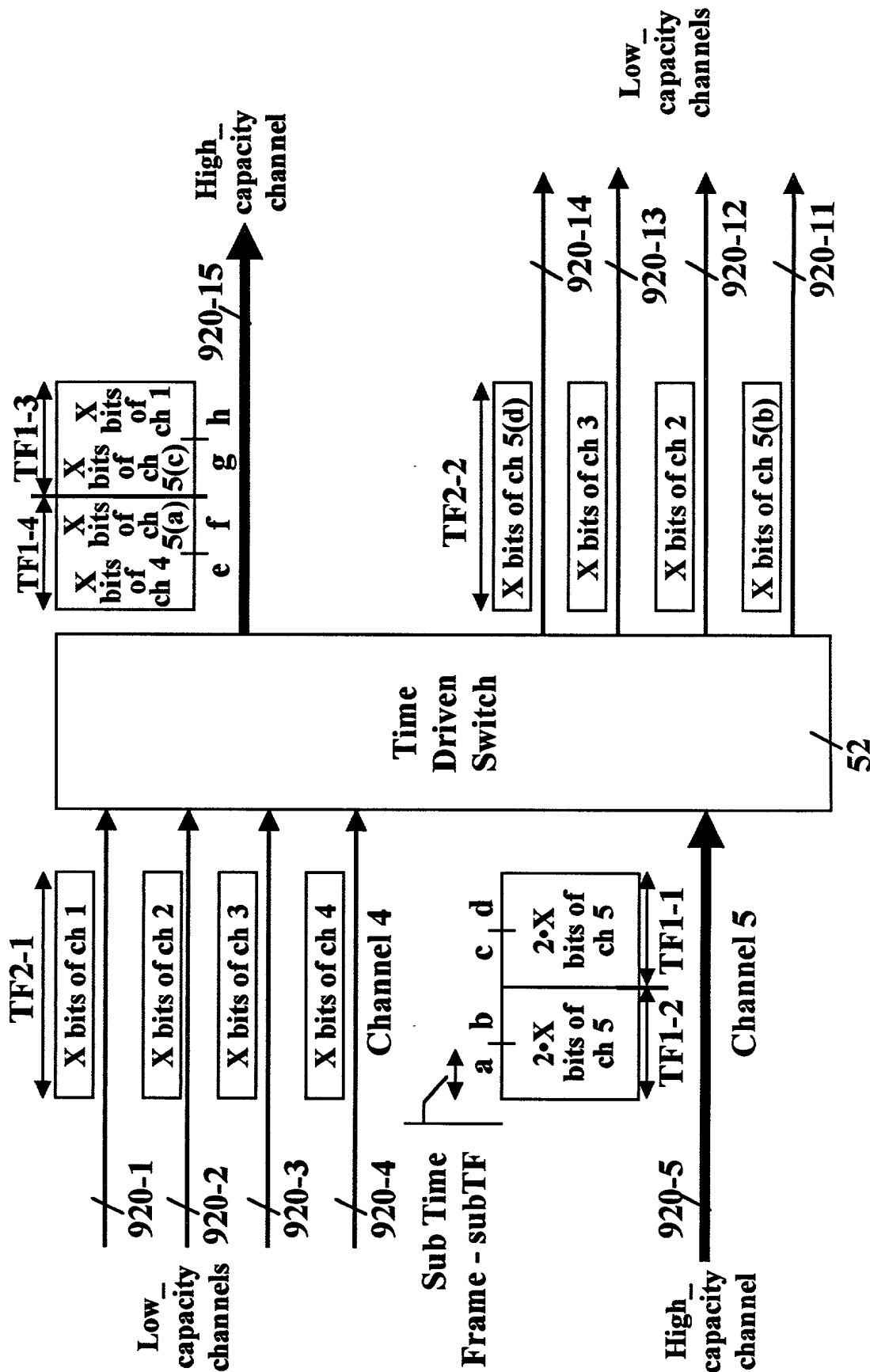


FIG. 11

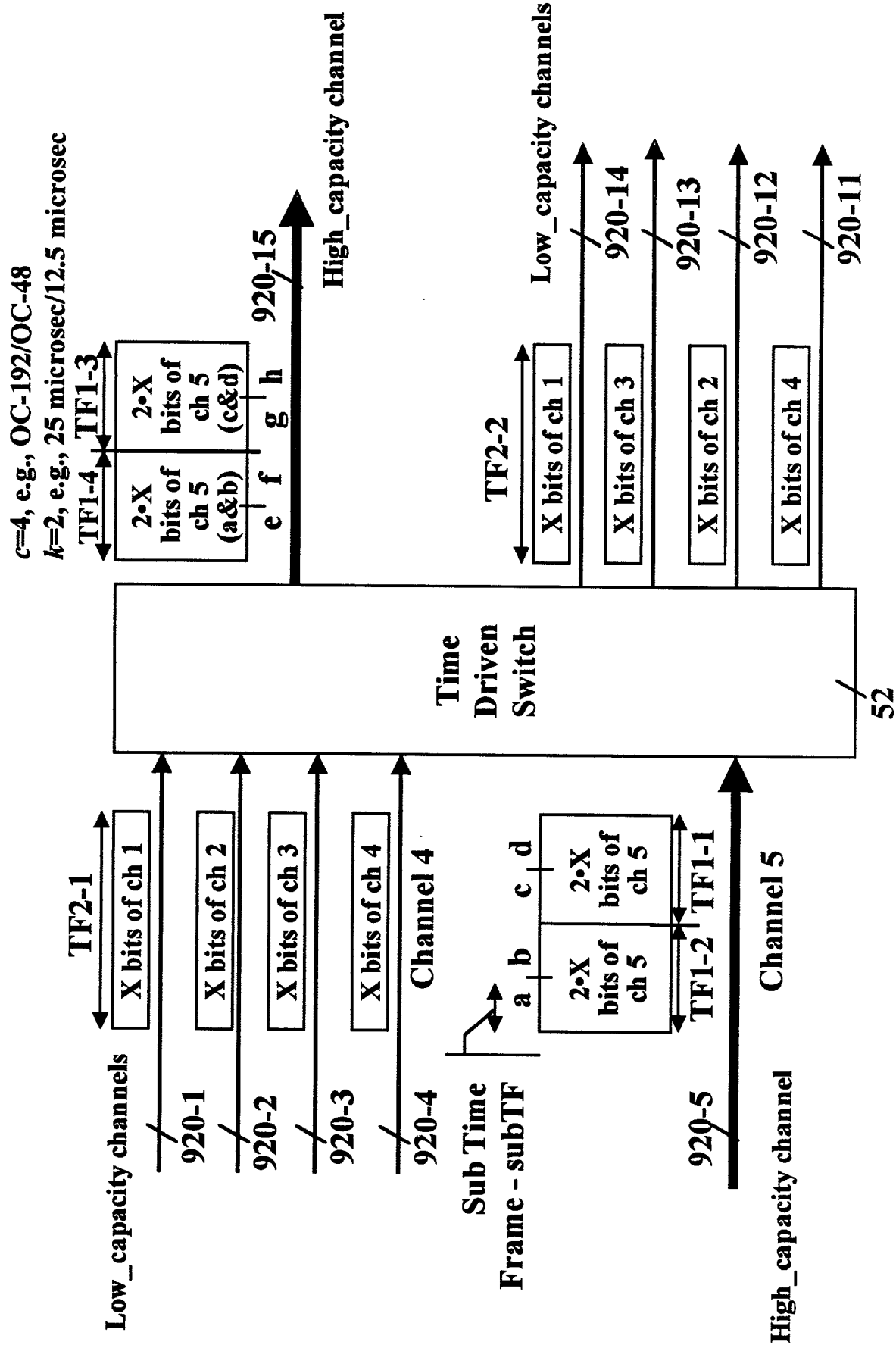


FIG. 12

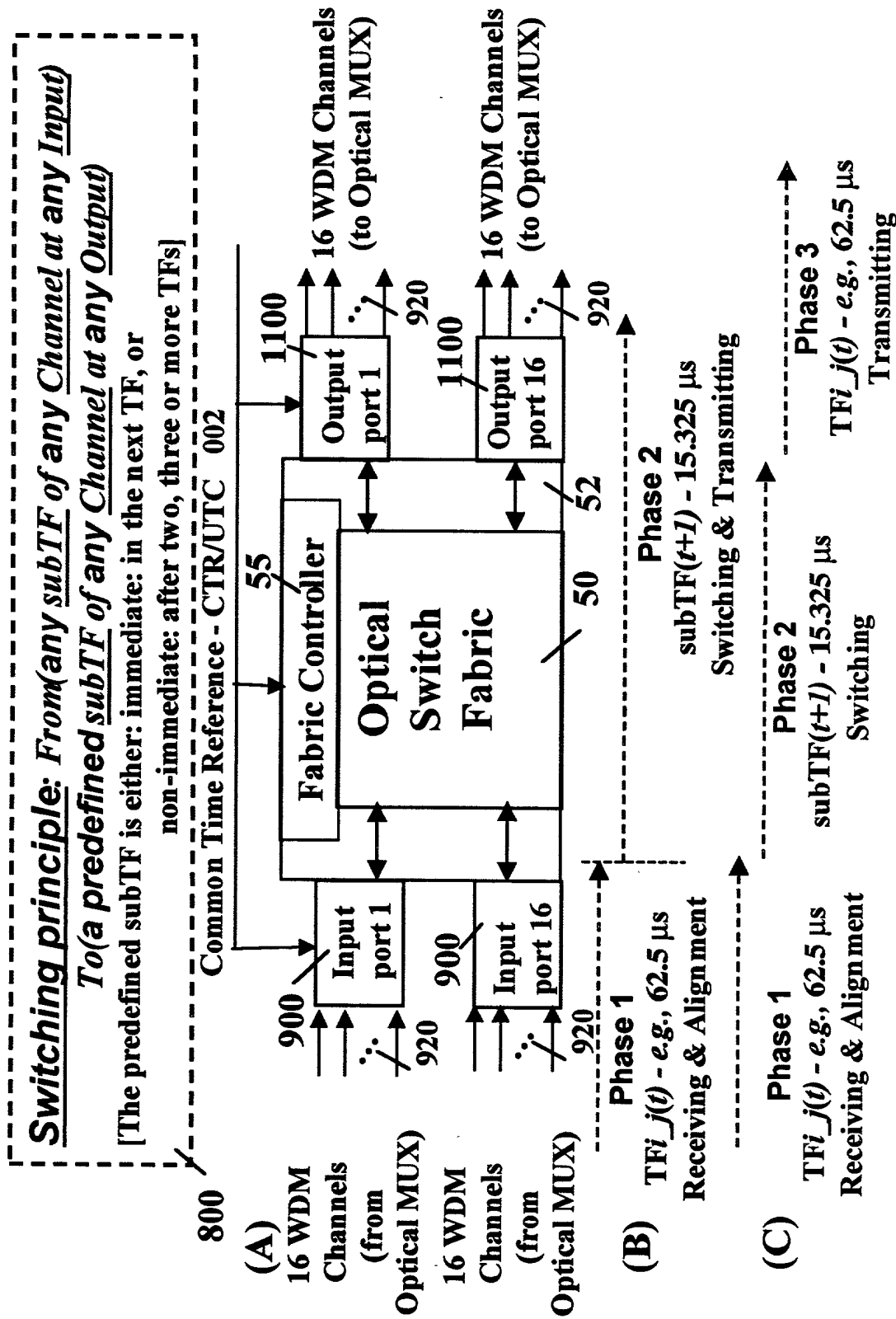


FIG. 13

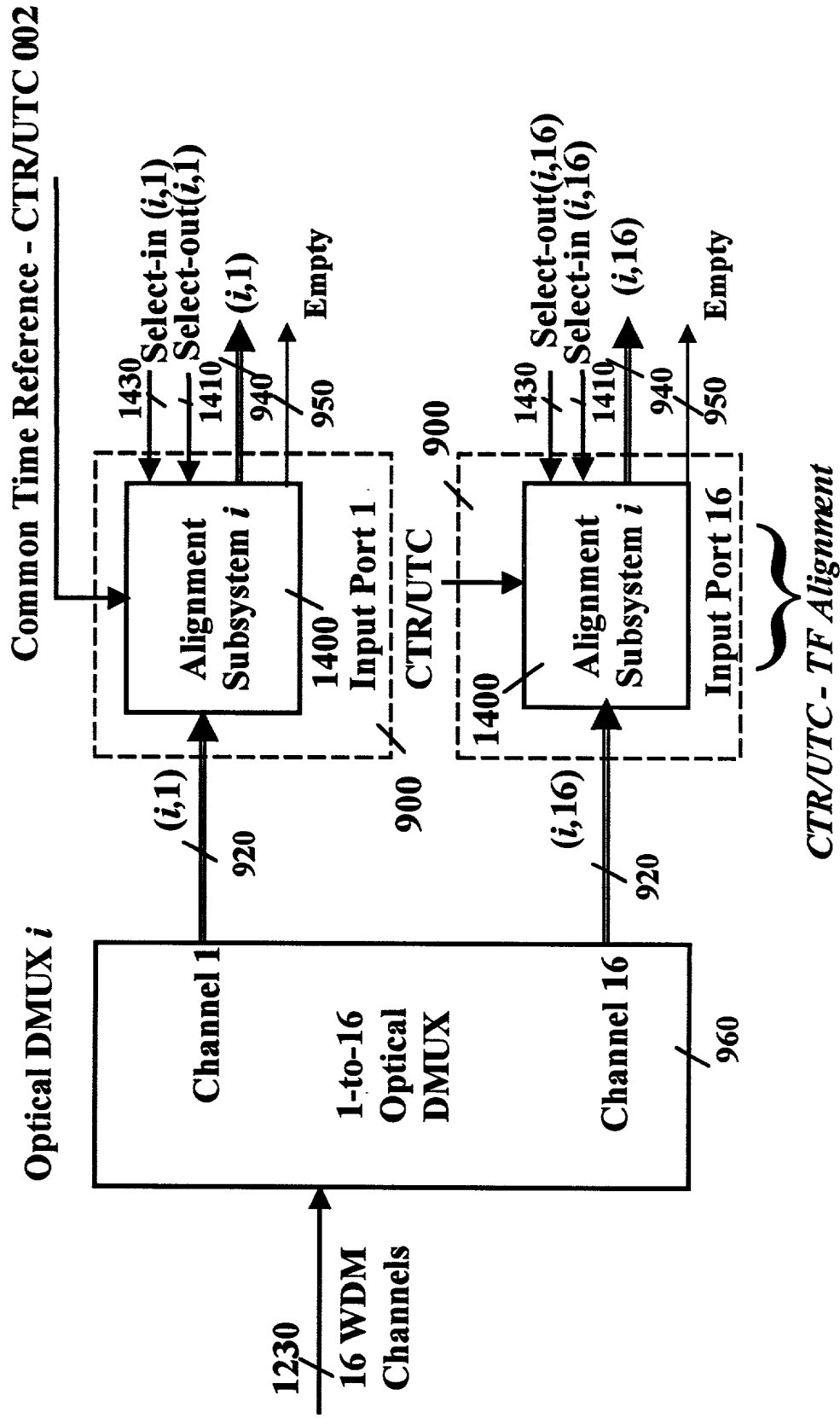


FIG. 14

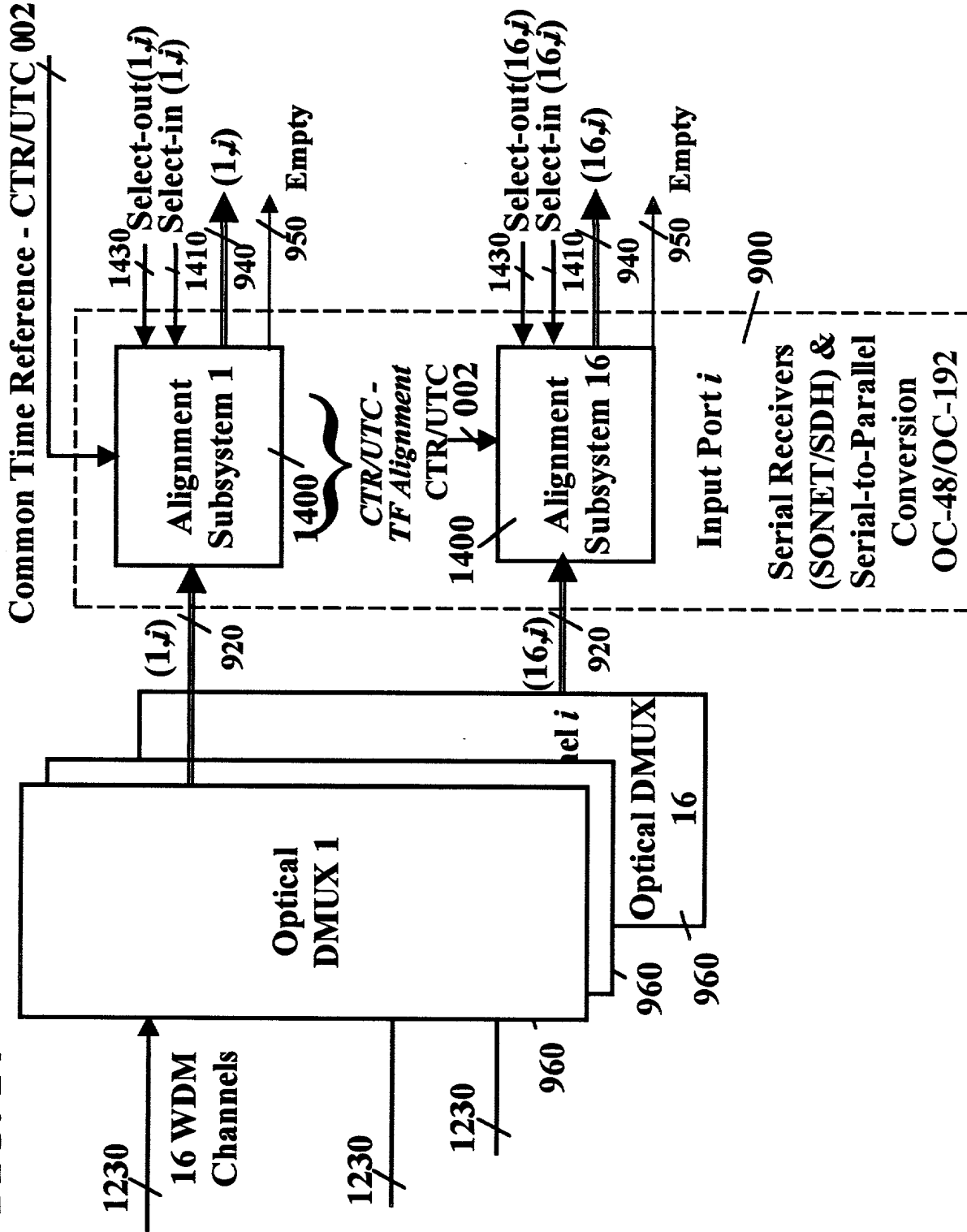


FIG. 15

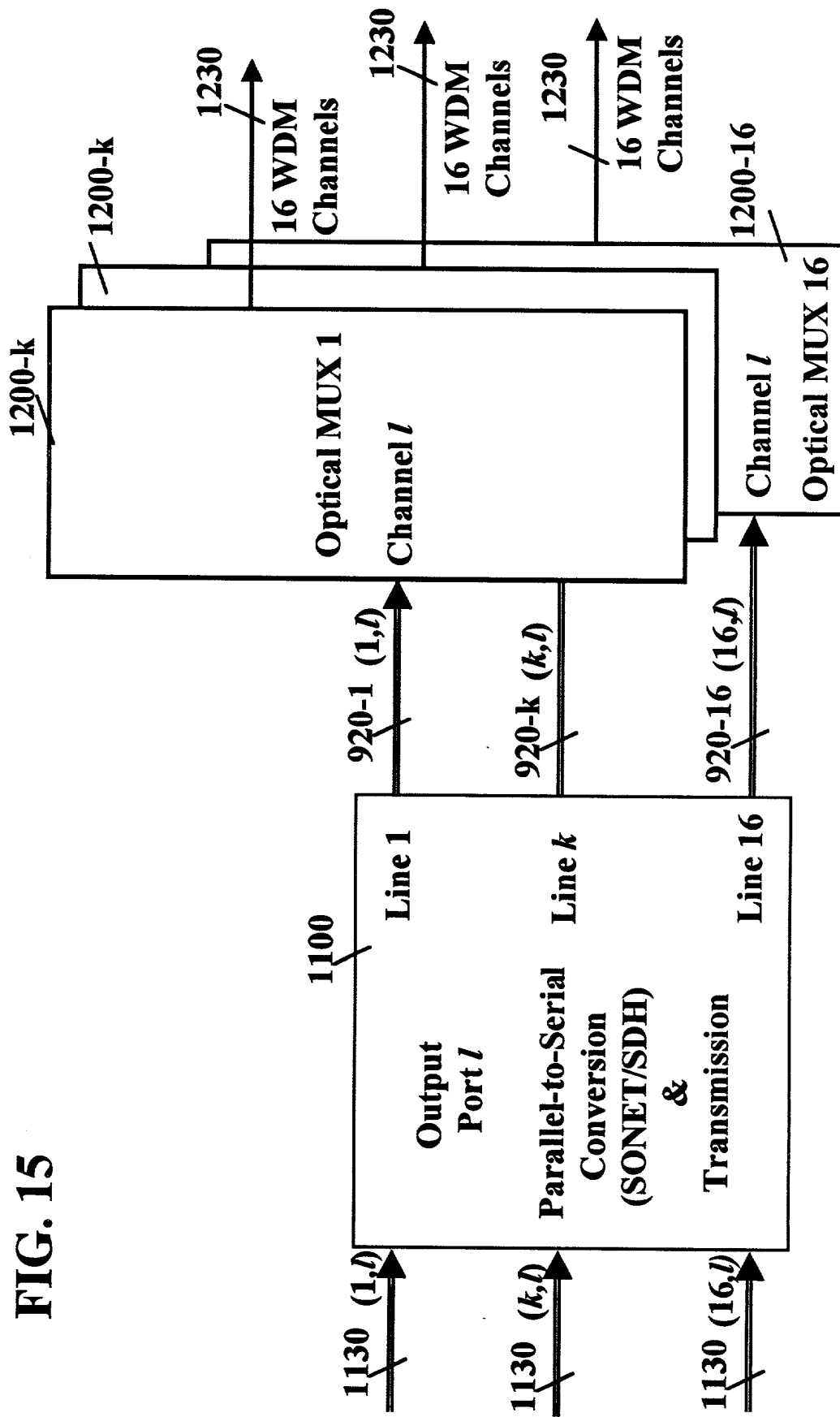


FIG. 16

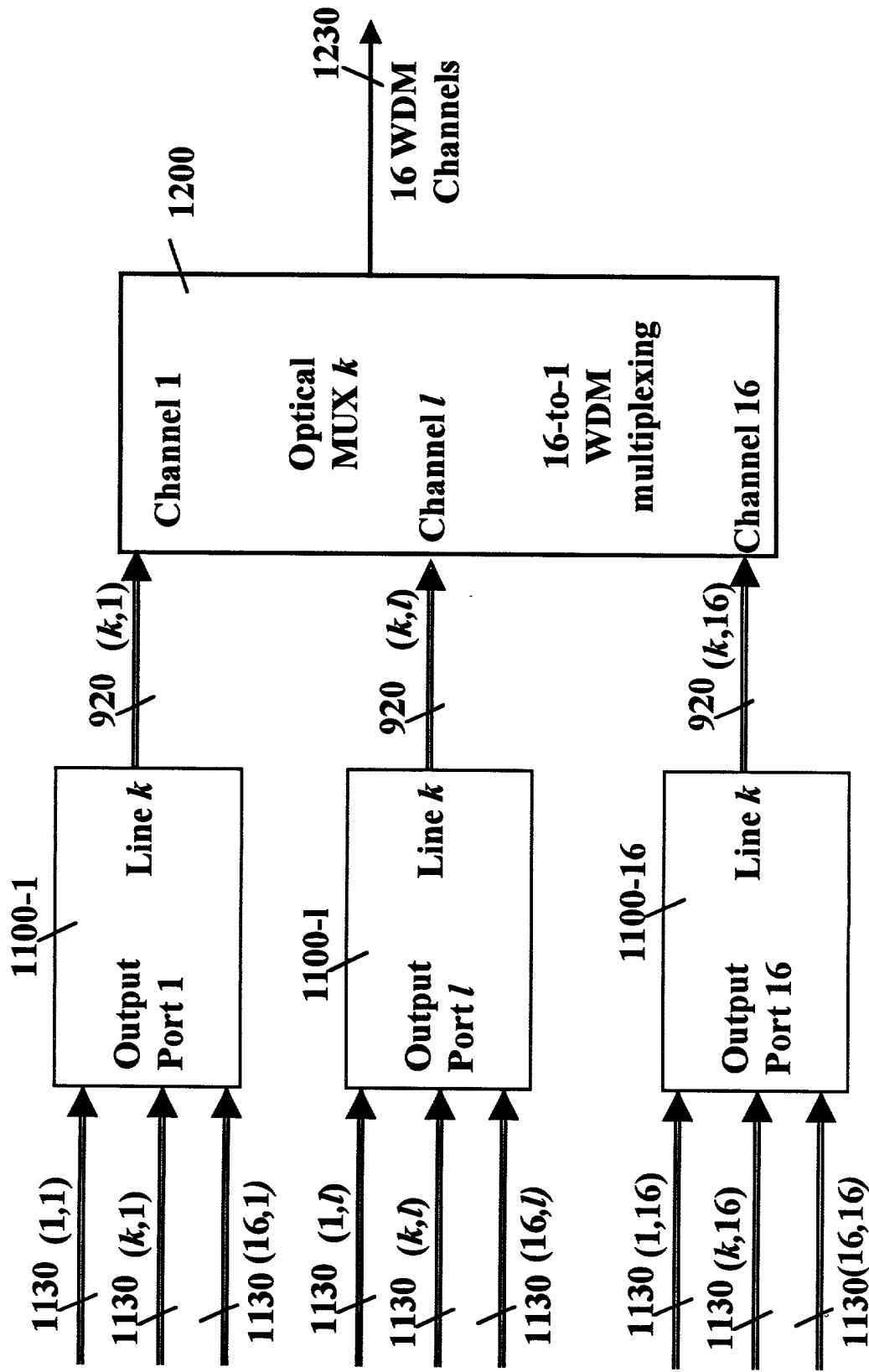


FIG. 17

N: number of input/output channels. E.g., N=256

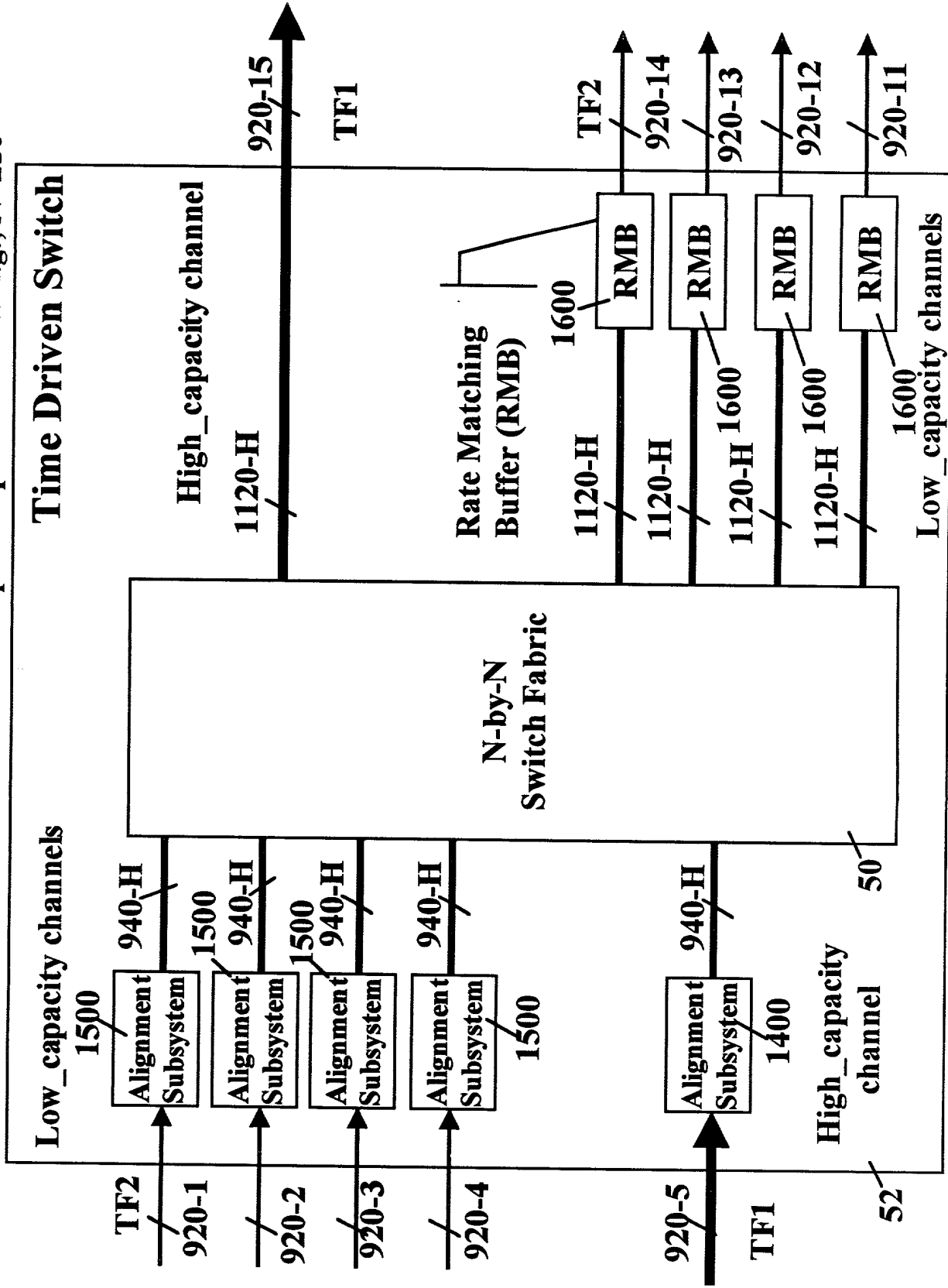
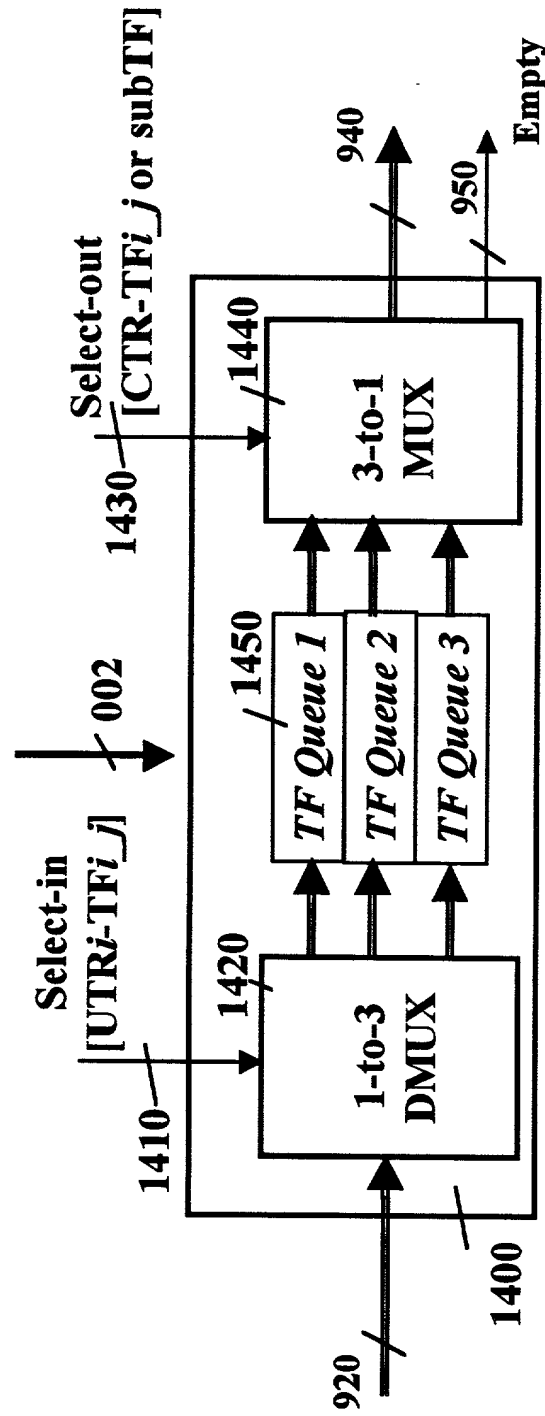


FIG. 18

TFi_j: Time frame duration on channel *j* at Input Interface *i*.
UTRi: UTR on link connected to Input Interface *i*
Common Time Reference - CTR/UTC



Alignment Subsystem for Channel *j* at Input Interface *i*
with a Plurality of Time Frame Queues

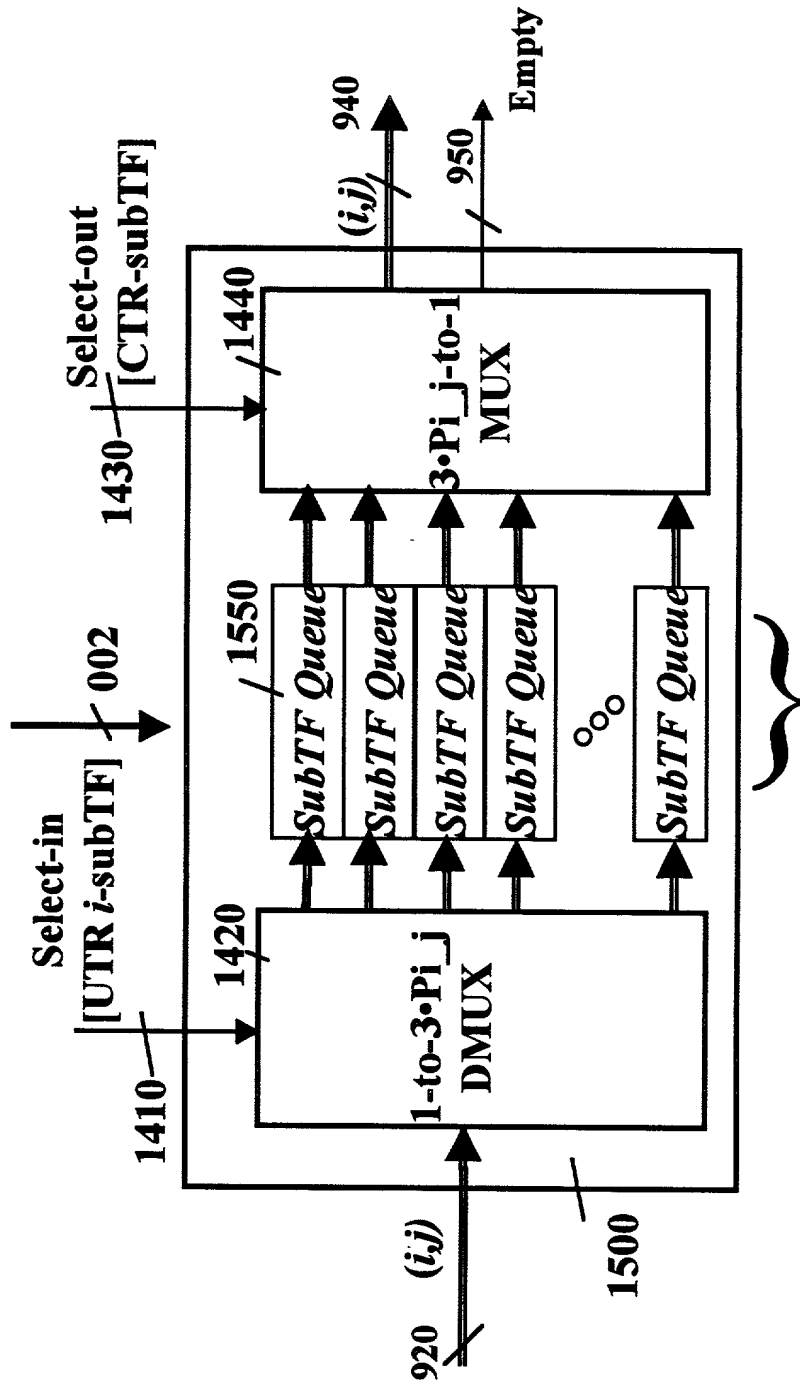
FIG. 19

TF_{i,j}: Time frame duration on channel *j* at Input Interface *i*.

UTR_i: UTR on link connected to Input Interface *i*

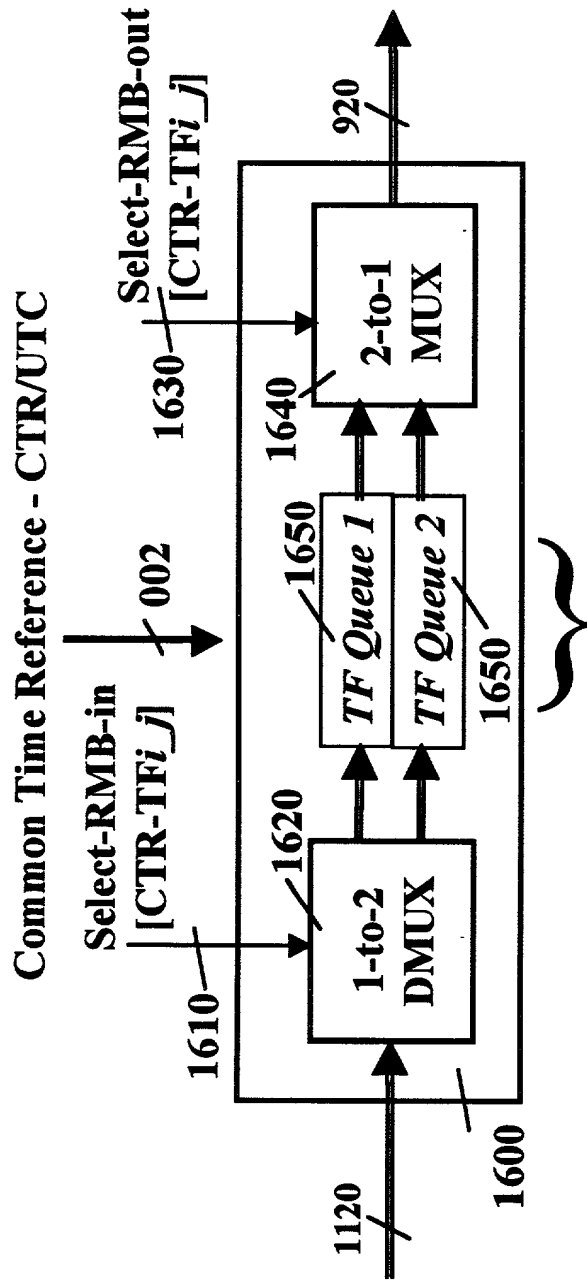
Pi_j = TF_{i,j}/subTF

Common Time Reference - CTR/UTC



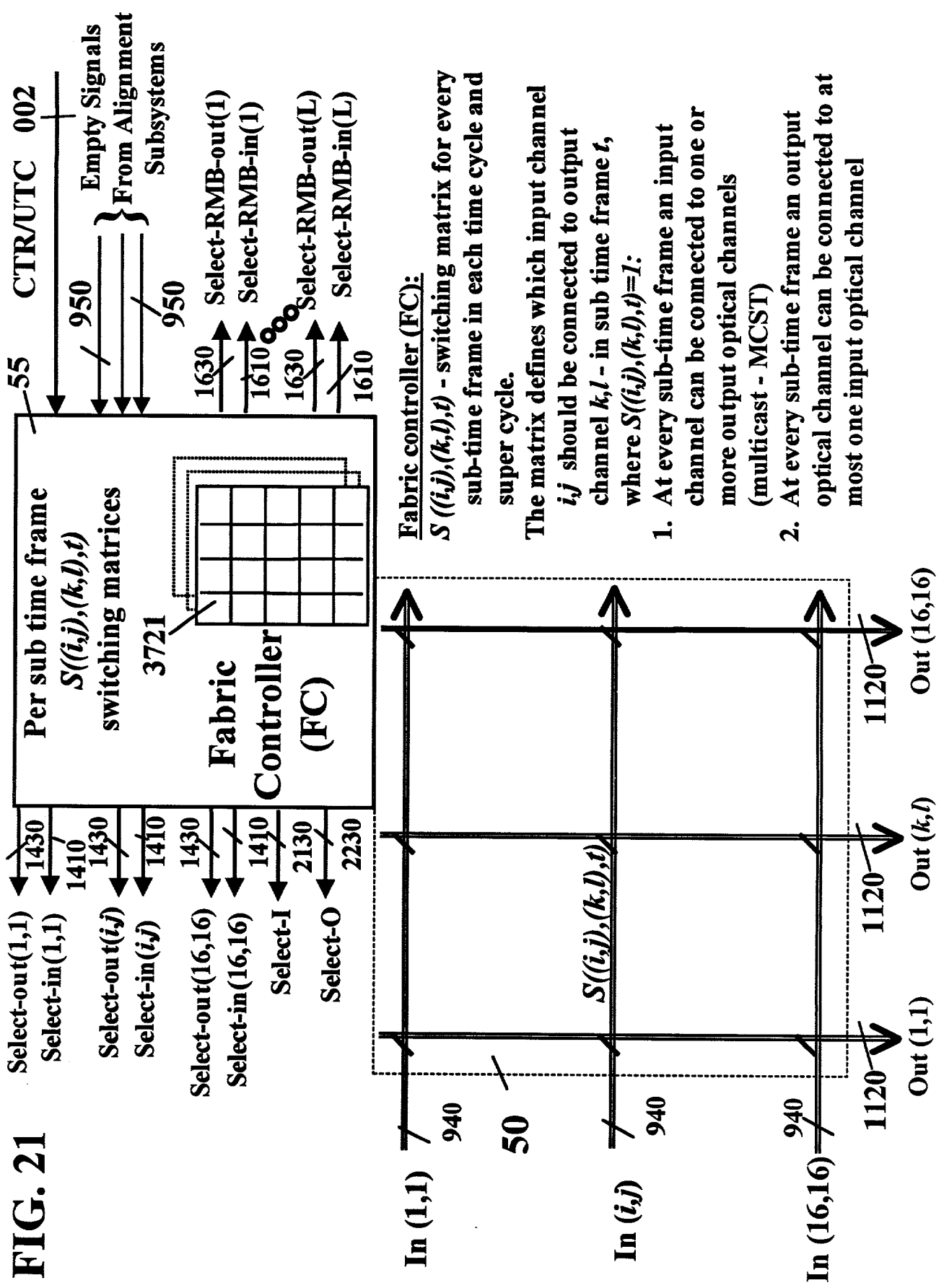
Alignment Subsystem for high capacity Channel *j* at Input Interface *i*
with a Plurality of Sub-Time Frame Queues

FIG. 18+2 TFi_j : Time frame duration on channel j at Input Interface i .
 UTR_i : UTR on link connected to Input Interface i



Rate Matching Buffer for Channel j at Output Interface i
with a Plurality of Time Frame Queues
 (Also single buffer with dual access memory with single phase switching and forwarding)

FIG. 21



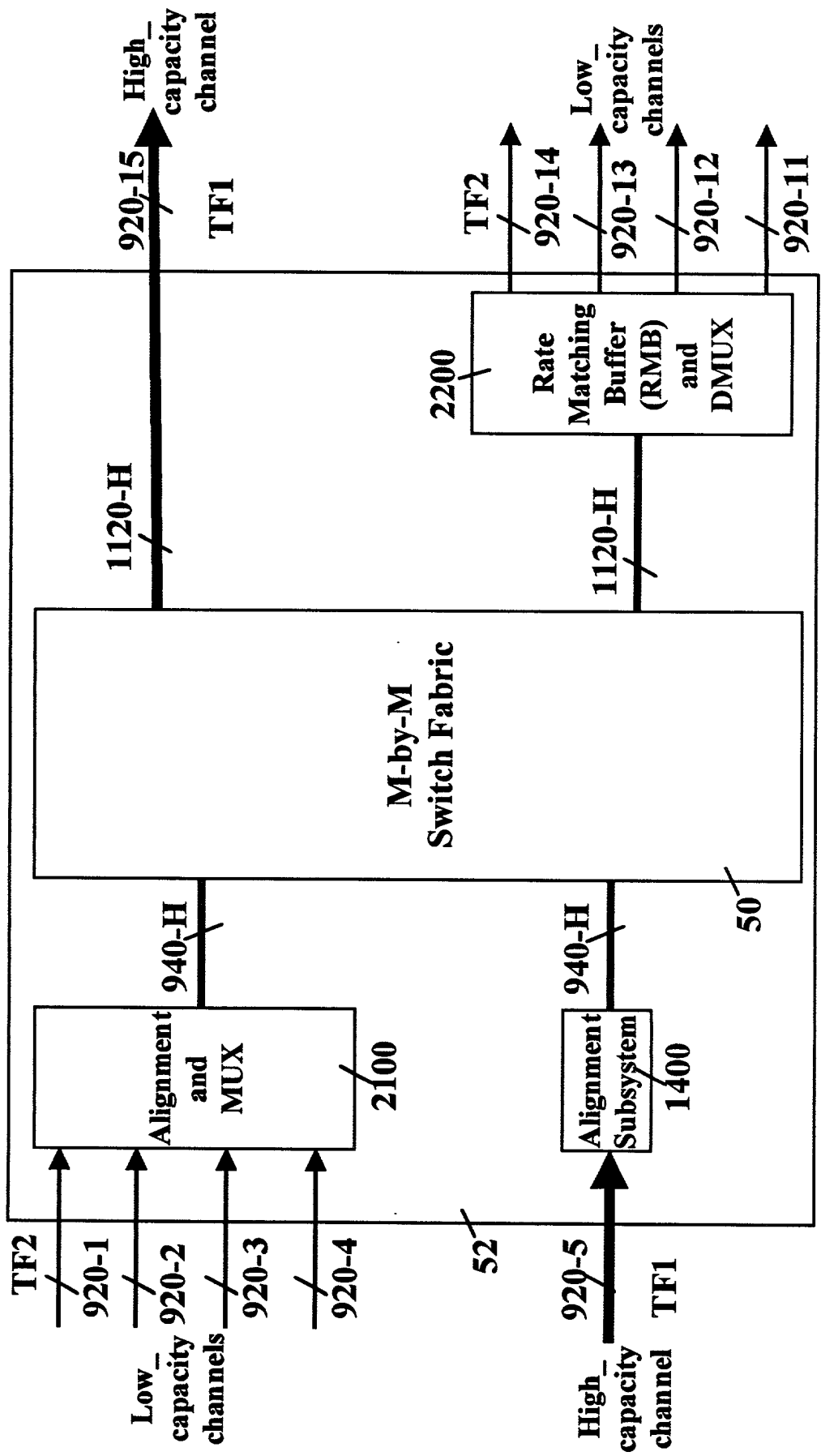
Fabric controller (FC):
 $S((i,j),(k,l),t)$ - switching matrix for every sub-time frame in each time cycle and super cycle.
 The matrix defines which input channel i,j should be connected to output channel k,l - in sub time frame t , where $S((i,j),(k,l),t)=1$:

1. At every sub-time frame an input channel can be connected to one or more output optical channels (multicast - MCST)
2. At every sub-time frame an output optical channel can be connected to at most one input optical channel

CTR/UTC 002

FIG. 22

N: number of input/output channels. E.g., N=256
 $M \cdot \text{High_capacity} = N_{\text{high}} \cdot \text{High_capacity} + N_{\text{low}} \cdot \text{Low_capacity}$
 $M < N$



Time Driven Switch

FIG. 23

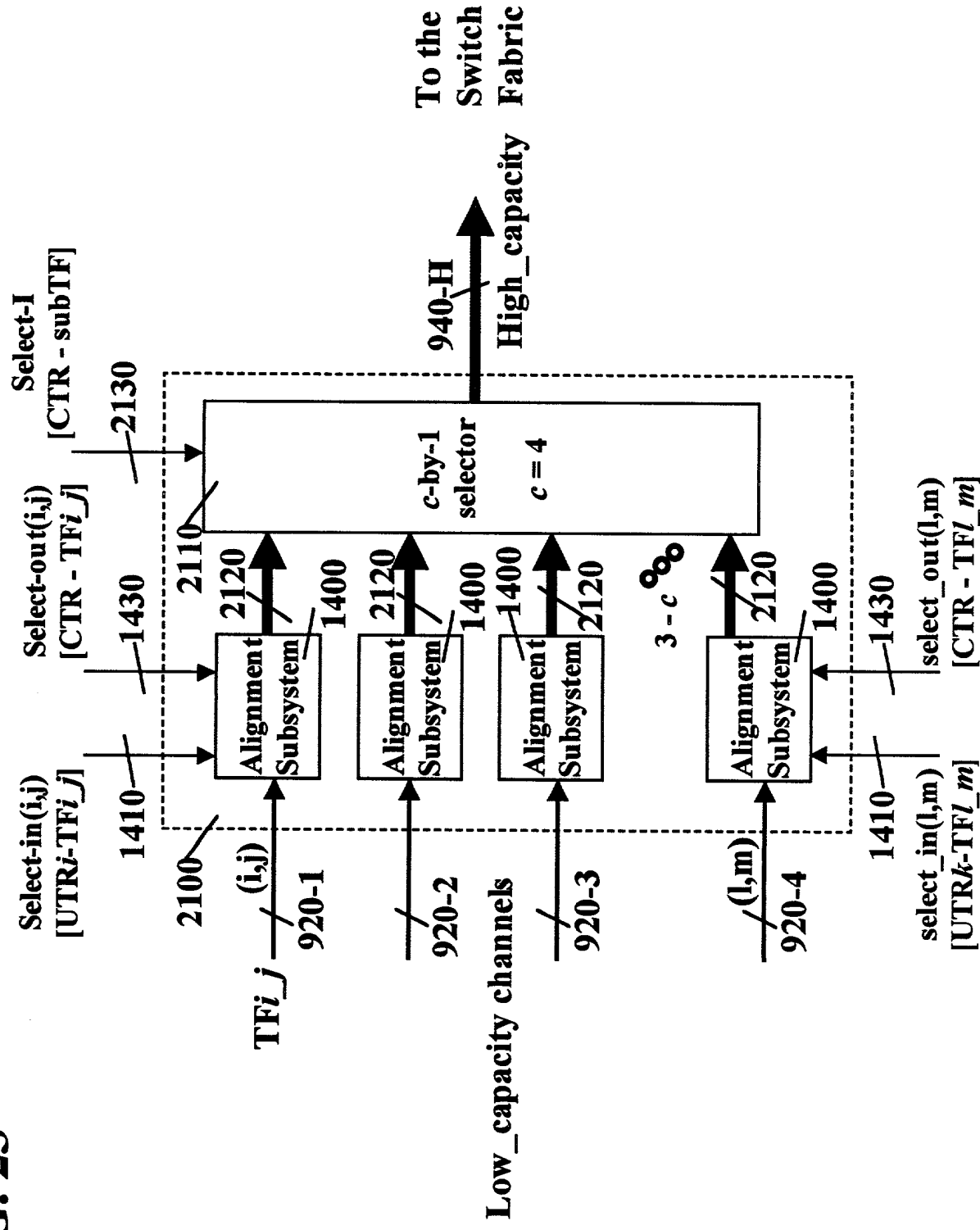


FIG. 24

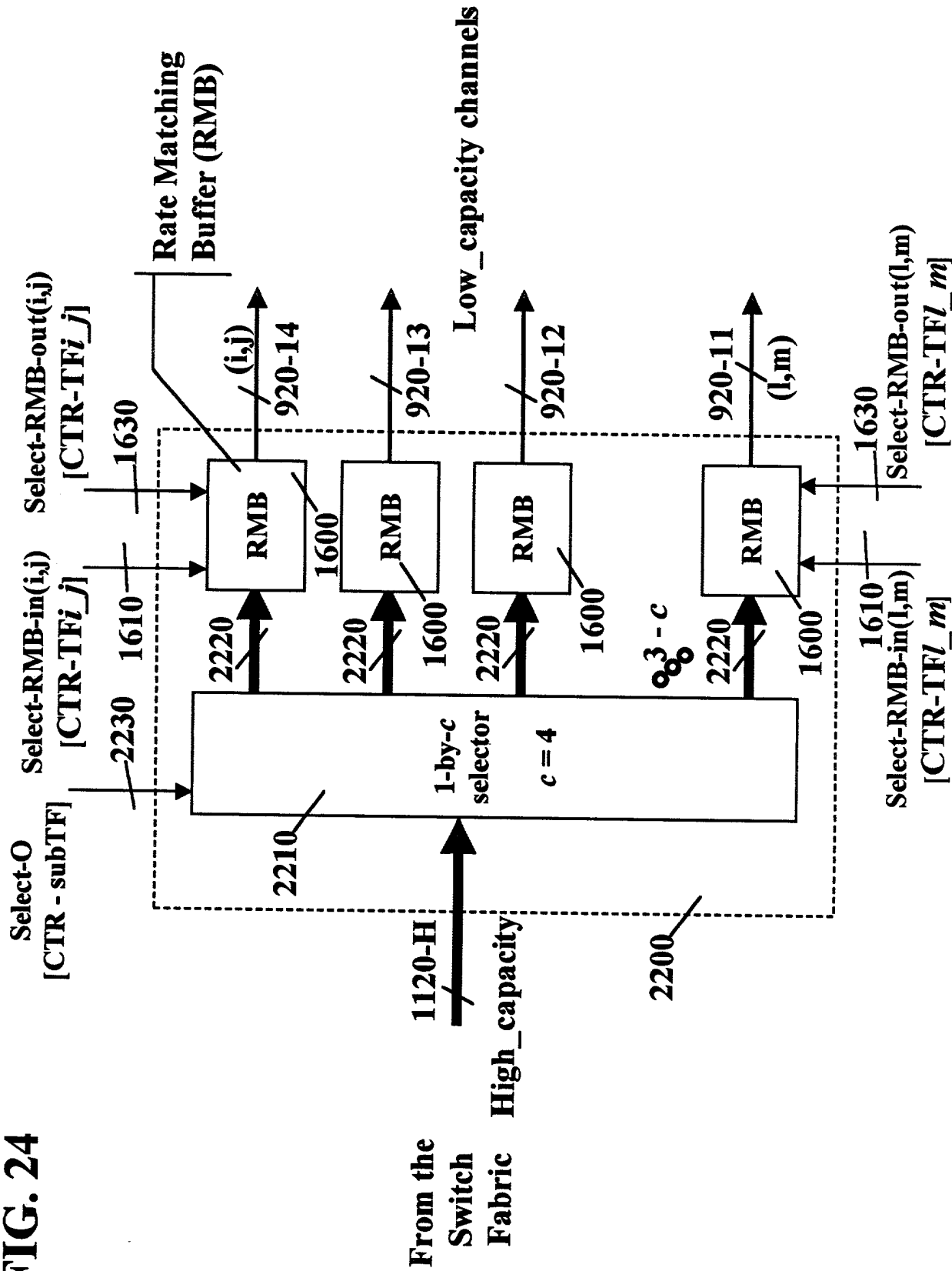


FIG. 25

N: number of input/output channels. E.g., $N=256$
 $L \cdot \text{Low_capacity} = N_{\text{high}} \cdot \text{High_capacity} + N_{\text{low}} \cdot \text{Low_capacity}$
 $L > N$

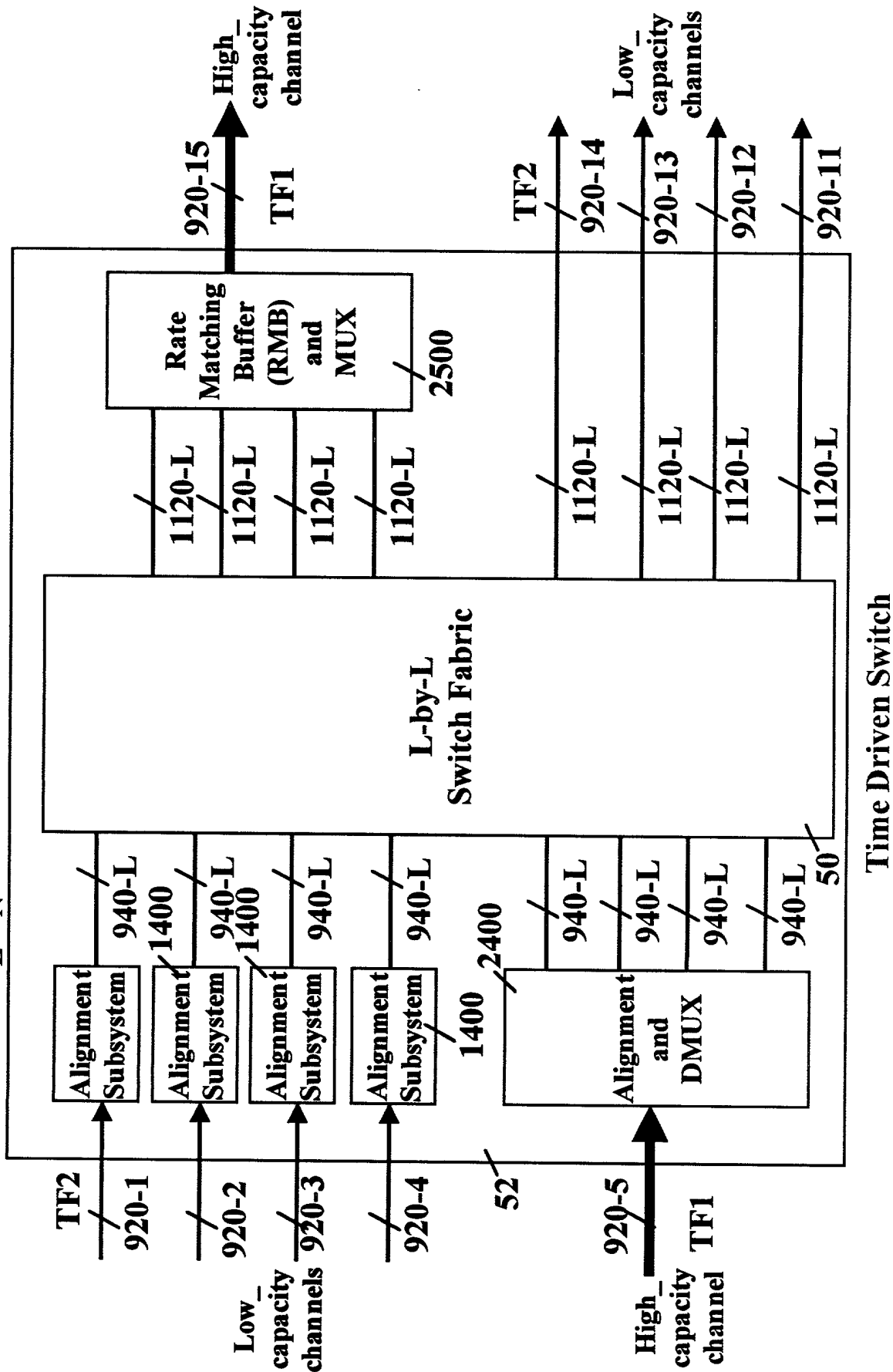


FIG. 26

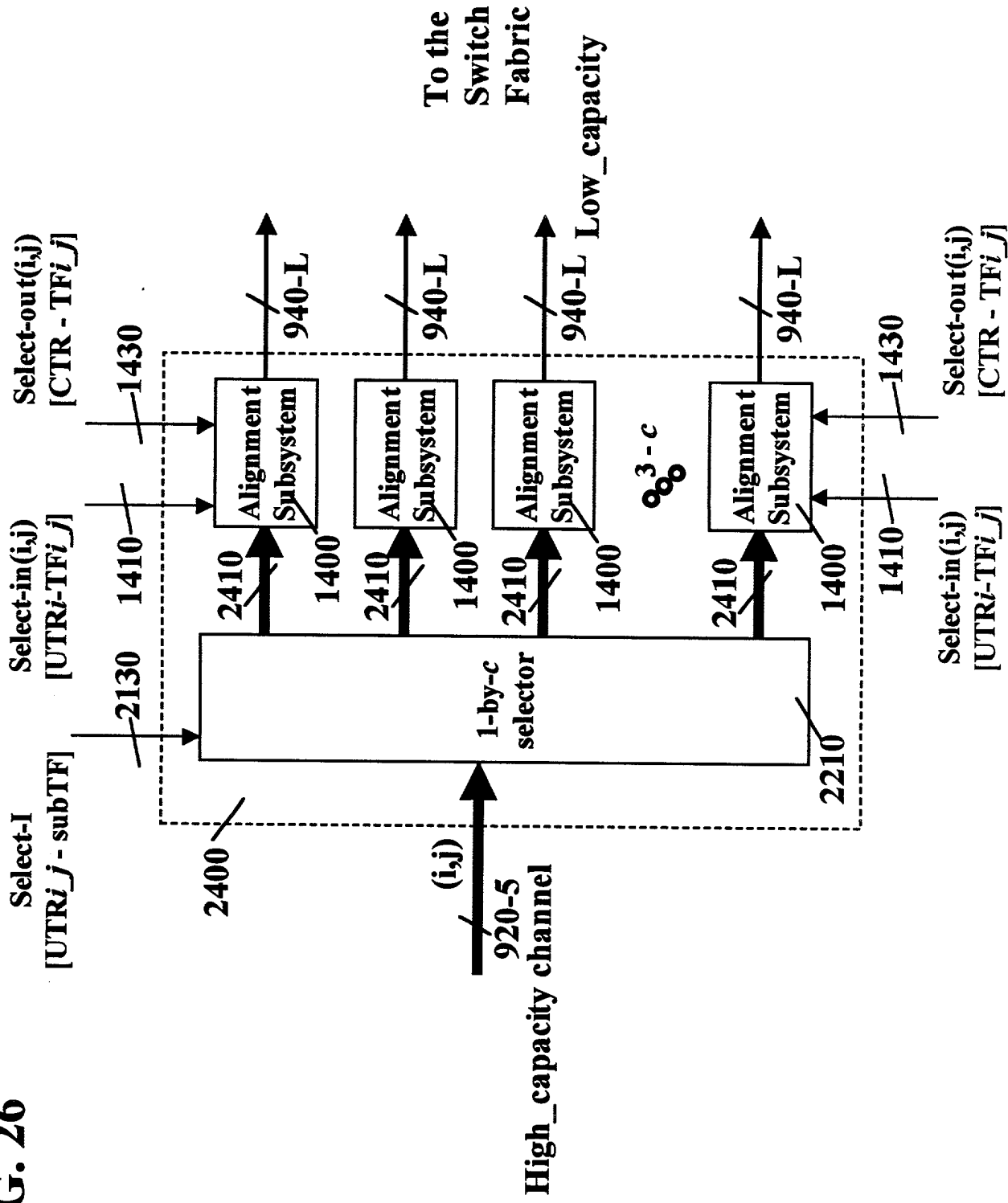
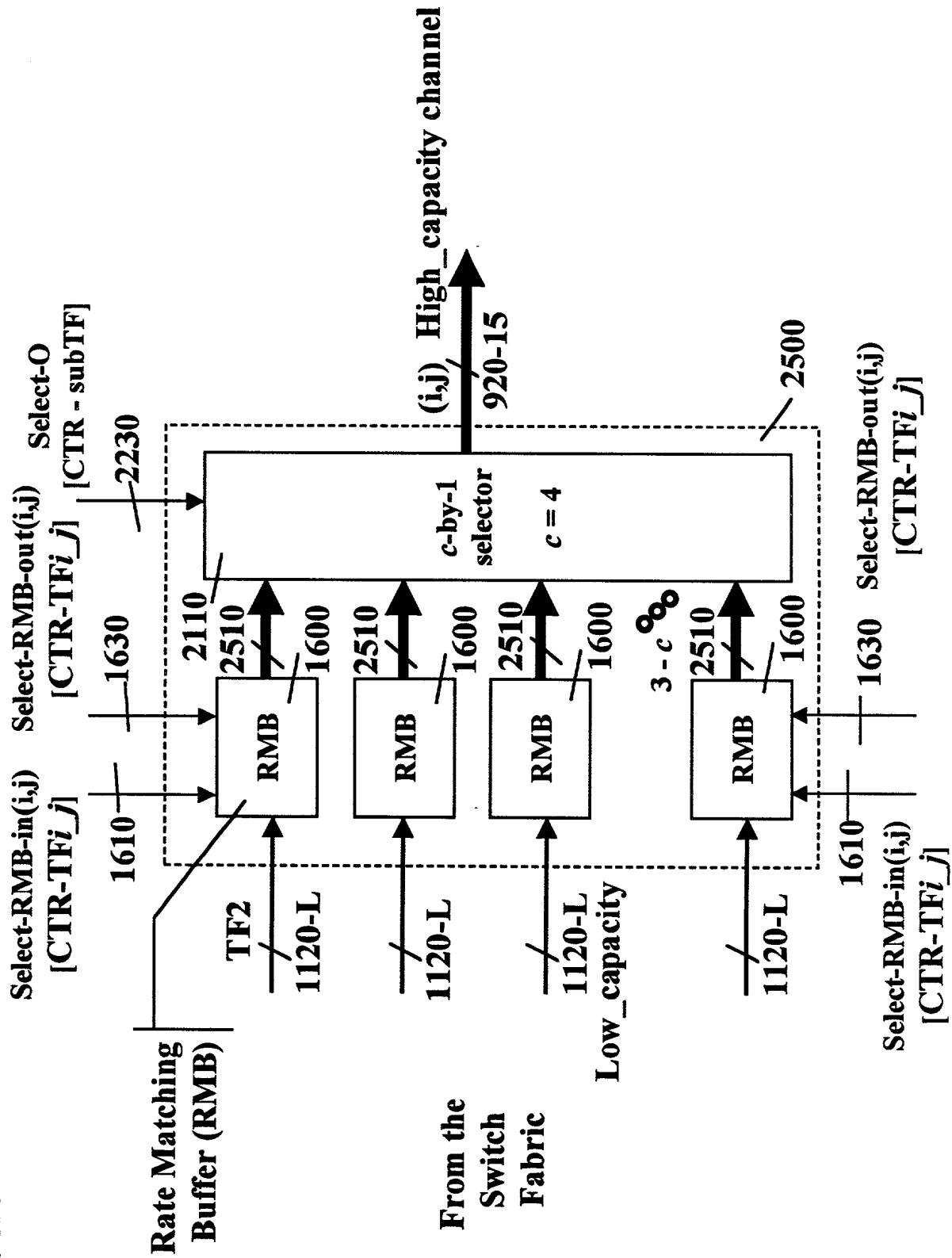


FIG. 27



N: number of input/output channels. E.g., $N=256$
 $L \cdot \text{Low_capacity} = N \cdot \text{High_capacity}$
 $L = c \cdot N > N$

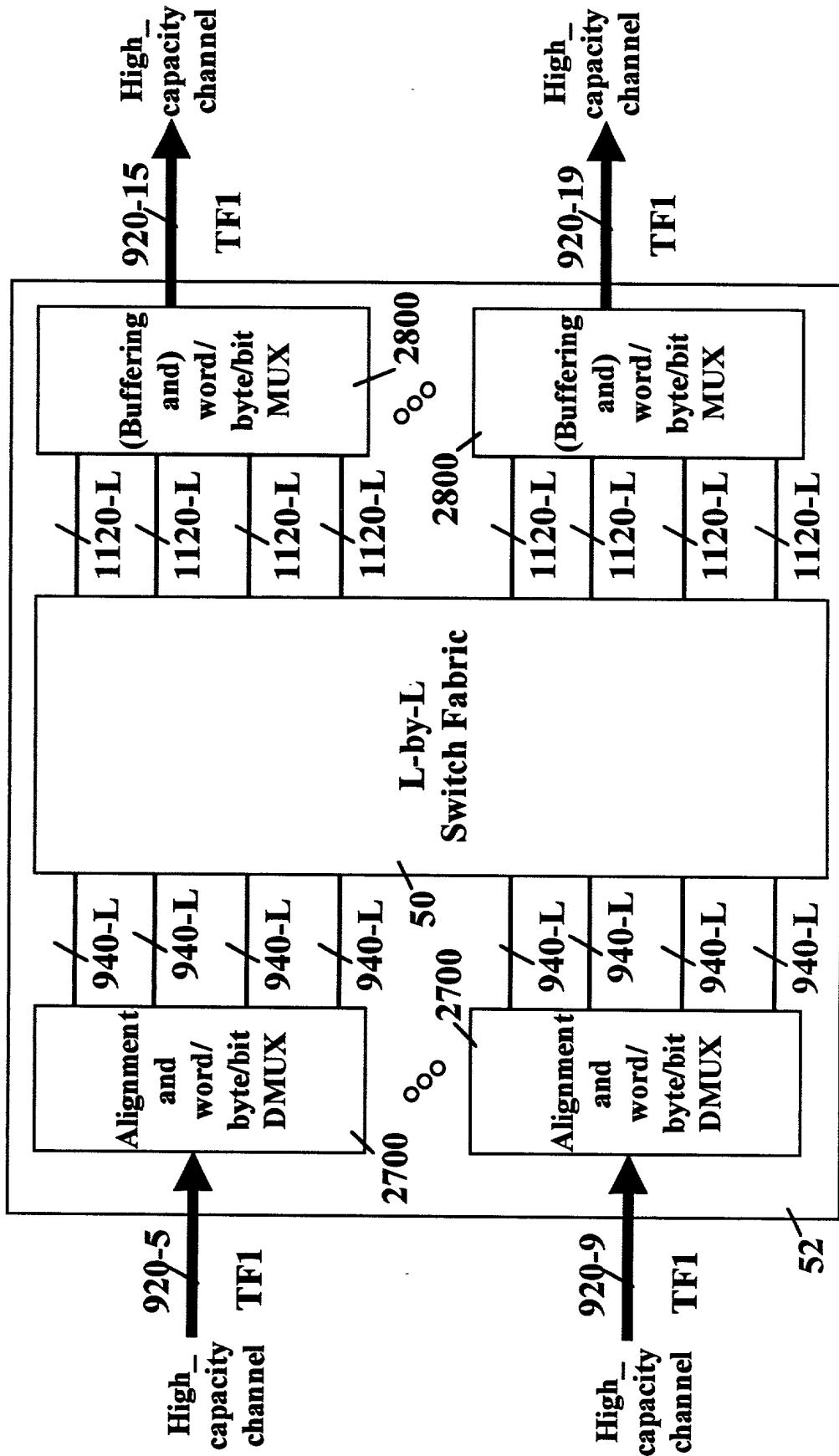


FIG. 29

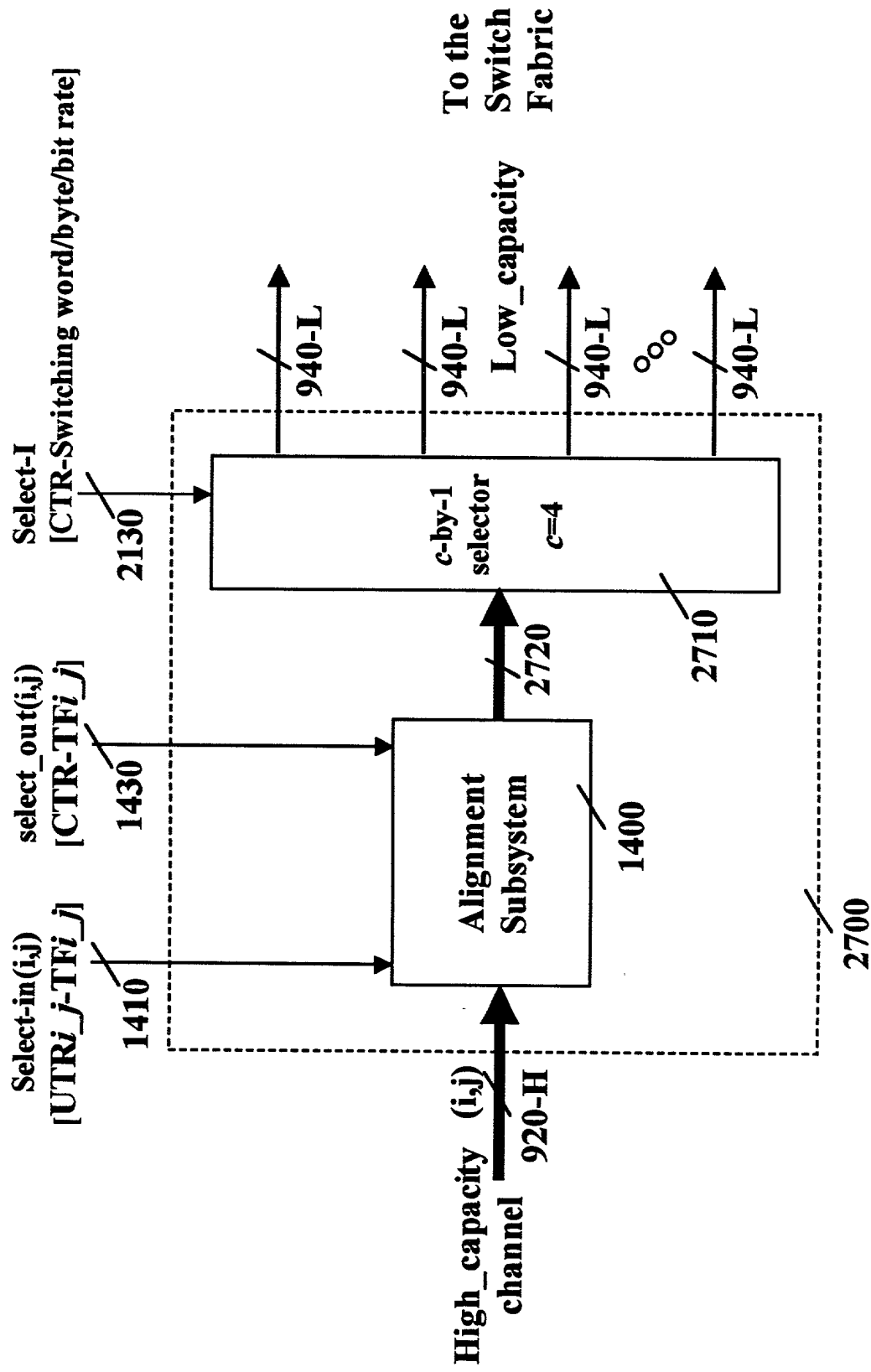
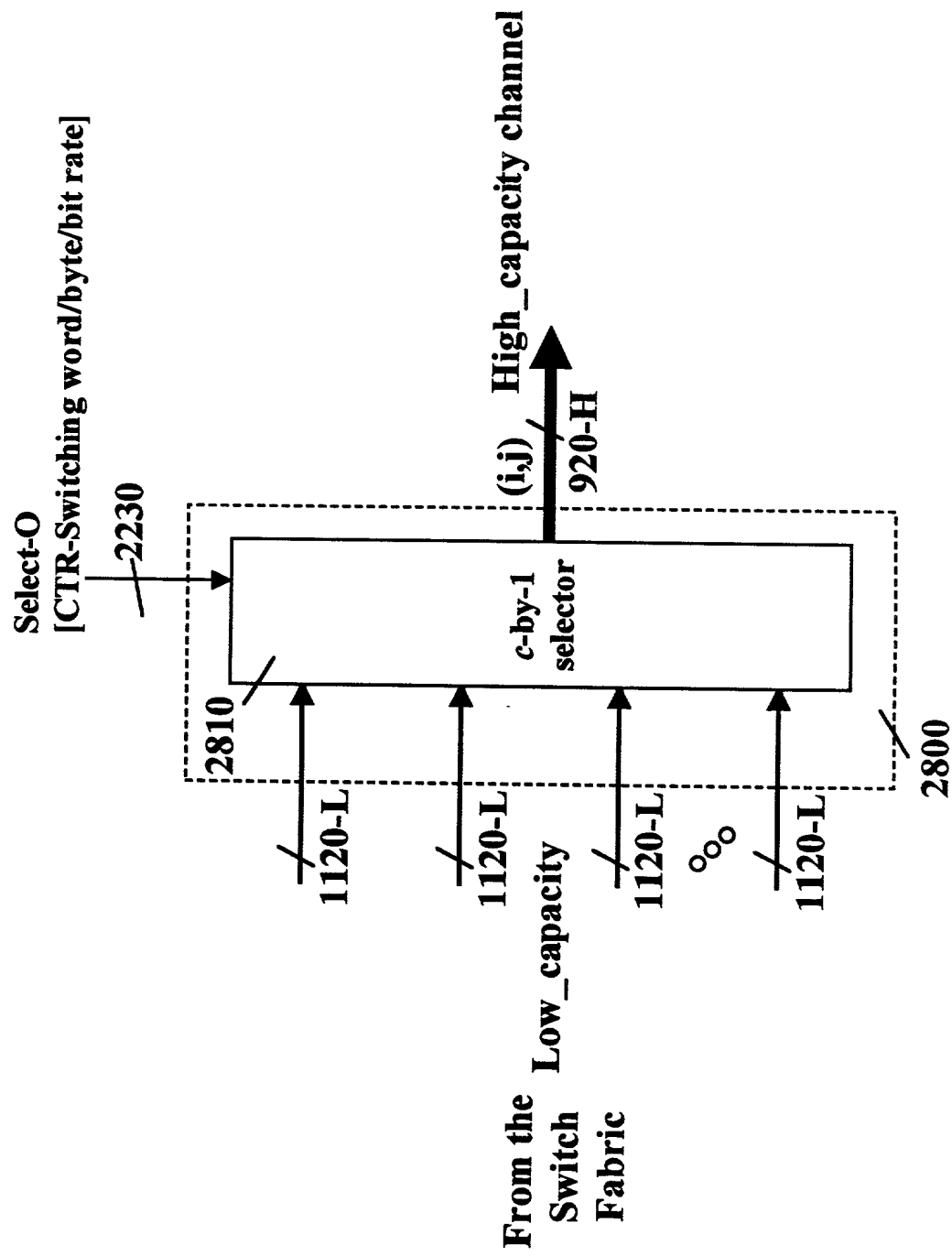


FIG. 30



[illegible]

FIG. 32

FIG. 32

Channel Capacity		TF Duration	TF Size		STS-1s	TFs/s
51.84	STS- 1	250	1620	1512	2	4000
		500	3240	3024	4	2000
		1000	6480	6048	8	1000
155.52	STS- 3	125	2430	2268	3	8000
		250	4860	4536	6	4000
		500	9720	9072	12	2000
622.08	STS- 12	62.5	4860	4536	6	16000
		125	9720	9072	12	8000
		250	19440	18144	24	4000
2488.32	STS- 48	62.5	19440	18144	24	16000
		31.25	9720	9072	12	32000
		15.625	4860	4536	6	64000
9953.28	STS- 192	7.8125	9720	9072	12	128000
		15.625	19440	18144	24	64000
		125	15625	15625	19.3	8000
1000	GE	100	12500	12500	15.4	10000
		80	10000	10000	12.3	12500
		15.625	19531.25	19531.3	24.1	64000
10000	10GE	12.5	15625	15625	19.3	80000
		10	12500	12500	15.4	100000

FIG. 33

Ch Capacity		TF Dur.	TF Size	GE TFs	TFs/s
1000	GE	80	10000	1.0	12500
51.84	STS- 1	250	1512	0.15	4000
		500	3024	0.30	2000
		1000	6048	0.60	1000
155.5	STS- 3	125	2268	0.23	8000
		250	4536	0.45	4000
		500	9072	0.91	2000
622.1	STS- 12	62.5	4536	0.45	16000
		125	9072	0.91	8000
		250	18144	1.81	4000
2488	STS- 48	62.5	18144	1.81	16000
		31.25	9072	0.91	32000
		15.625	4536	0.45	64000
9953	STS- 192	7.8125	9072	0.91	128000
		15.625	18144	1.81	64000
10000	10GE	8	10000	1.00	125000
		16	20000	2.00	62500

FIG. 34

Ch Capacity		TF Dur.	TF Size	GE TFs	TFs/s
1000	GE	62.5	7812.5	1.0	16000
51.84	STS- 1	250	1512	0.19	4000
		500	3024	0.39	2000
		1000	6048	0.77	1000
155.52	STS- 3	125	2268	0.29	8000
		250	4536	0.58	4000
		500	9072	1.16	2000
622.08	STS- 12	62.5	4536	0.58	16000
		125	9072	1.16	8000
		250	18144	2.32	4000
2488.32	STS- 48	62.5	18144	2.32	16000
		31.25	9072	1.16	32000
		15.625	4536	0.58	64000
9953.28	STS- 192	7.8125	9072	1.16	128000
		15.625	18144	2.32	64000
		12.5	15625	2.00	80000
10000	10GE	25	31250	4.00	40000

FIG. 35

TF Alignment of UTR(i) to UTC - with three input queues - principle of operation:

The same queue is not used simultaneously for:

1. Receiving data packets from the serial link, and
2. Forwarding data packets to the switch

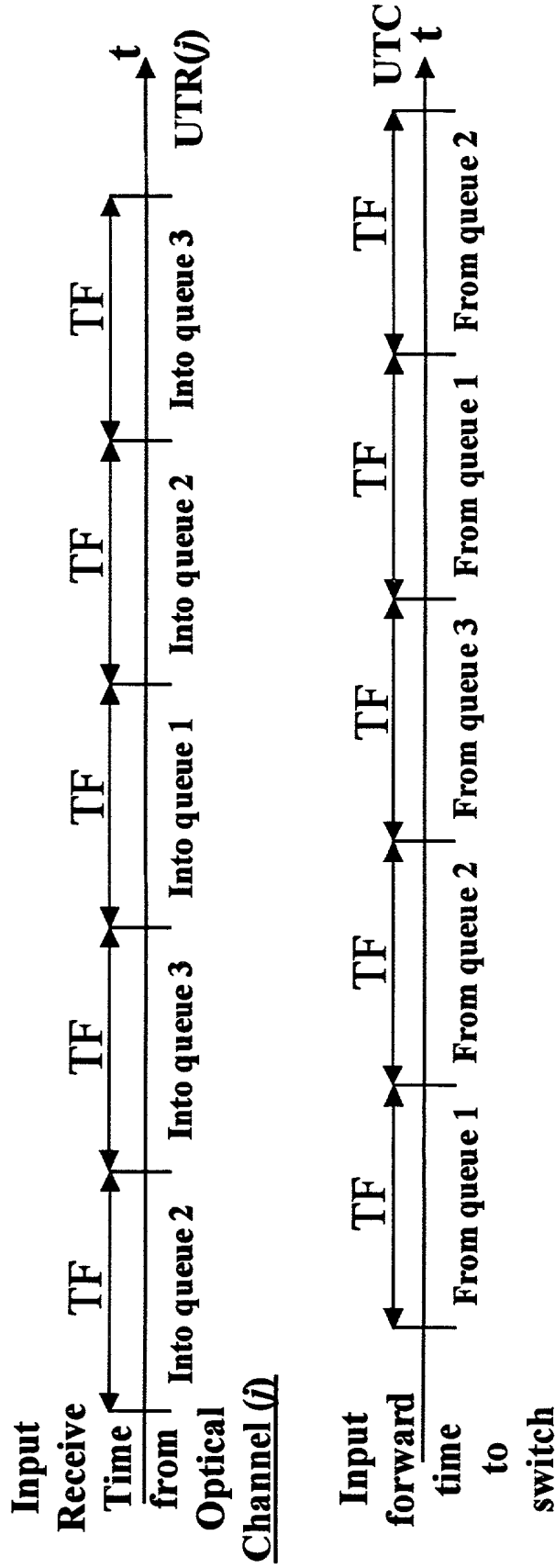


FIG. 36

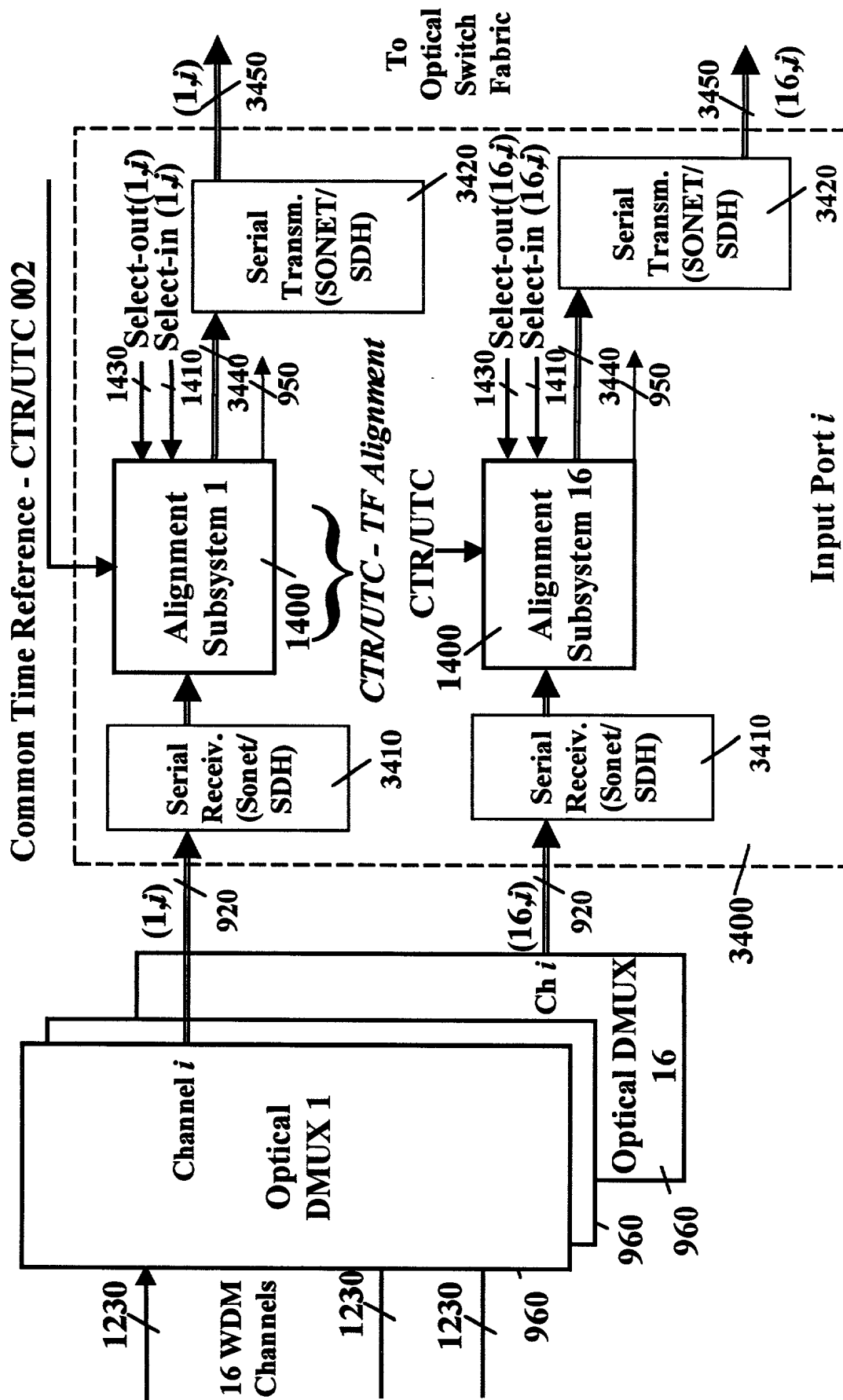


FIG. 37

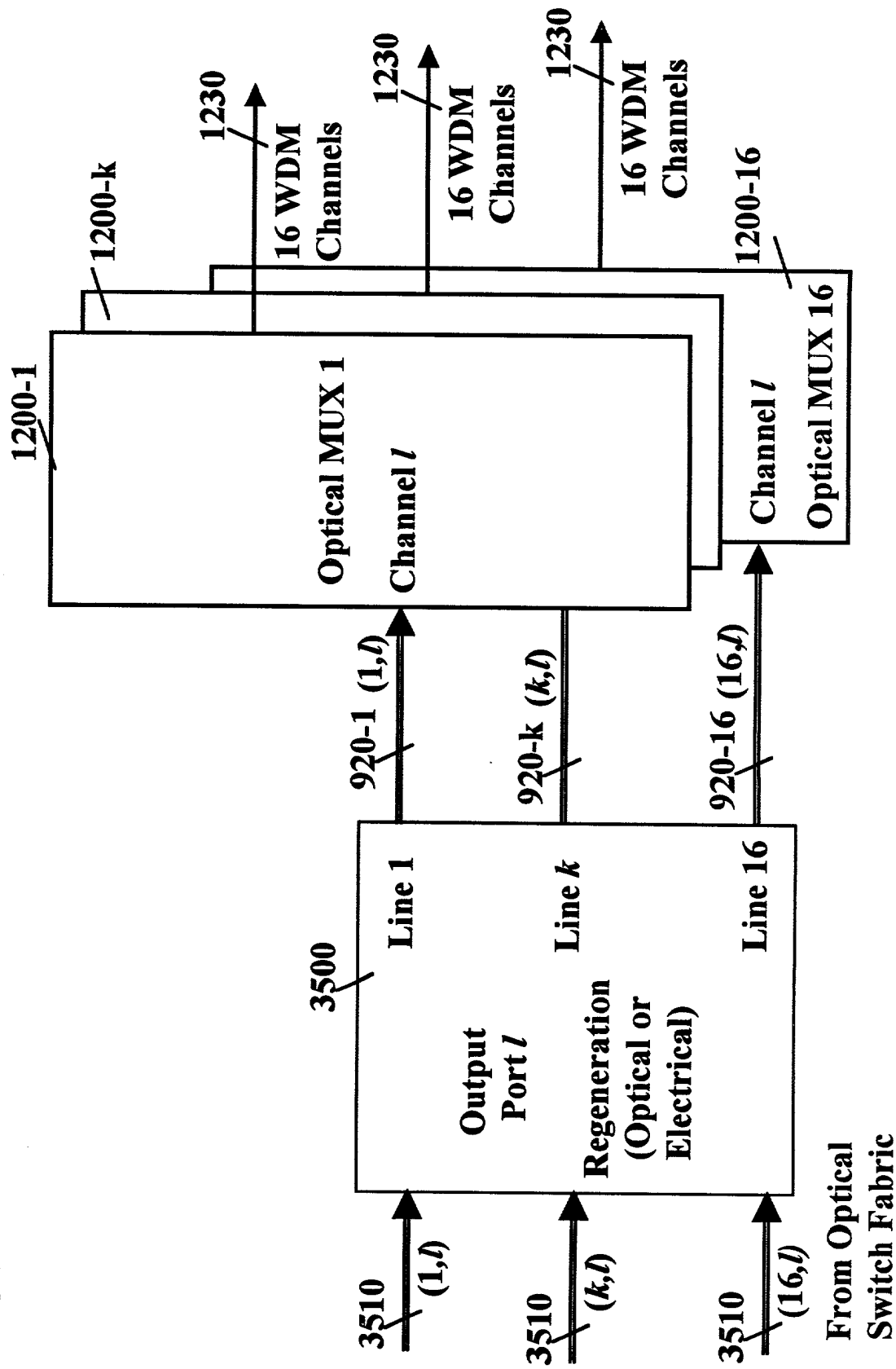


FIG. 38

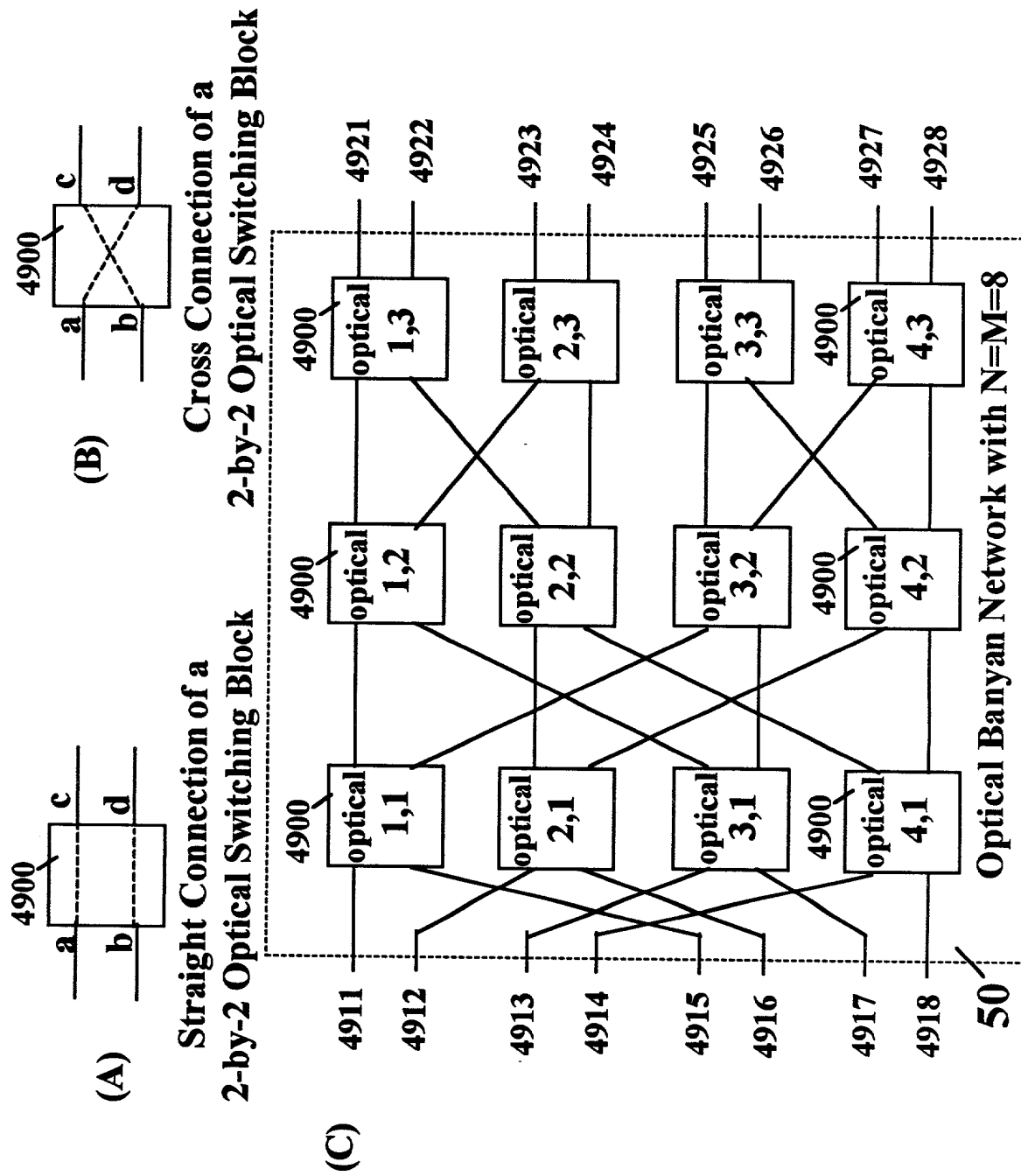
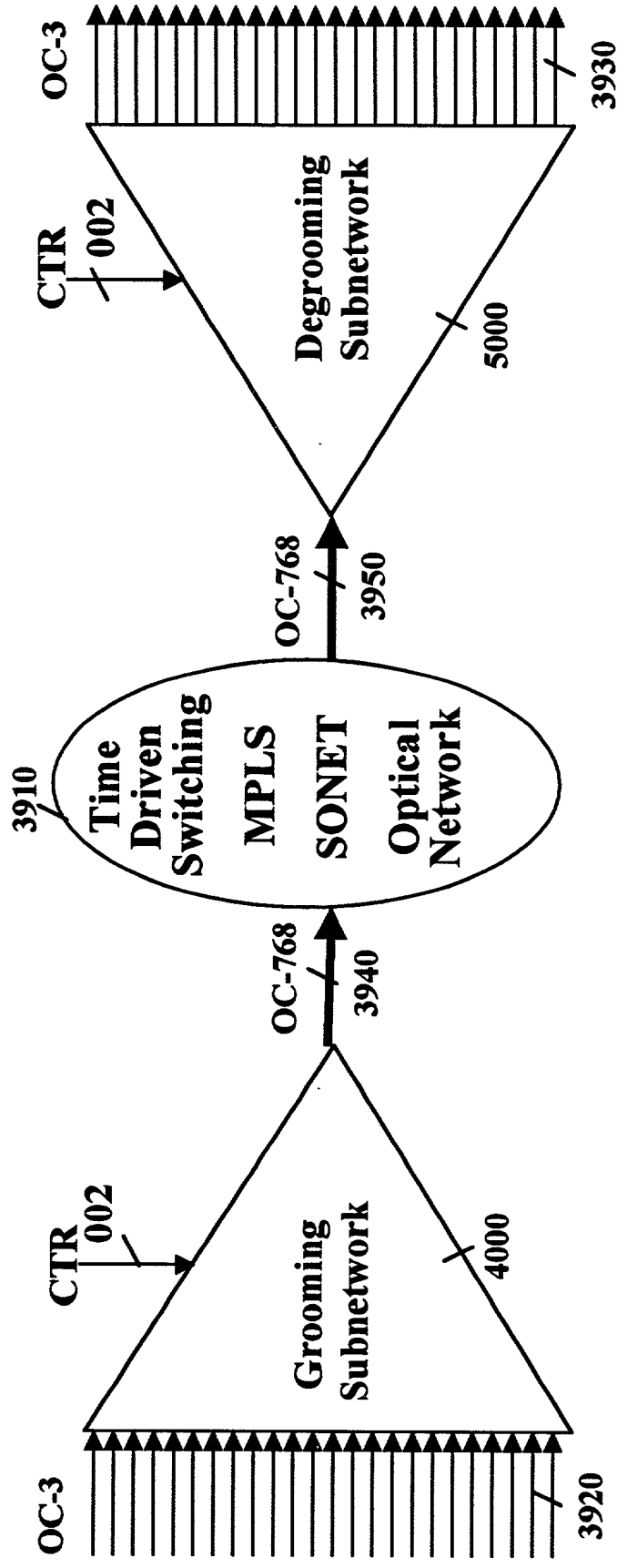


FIG. 39



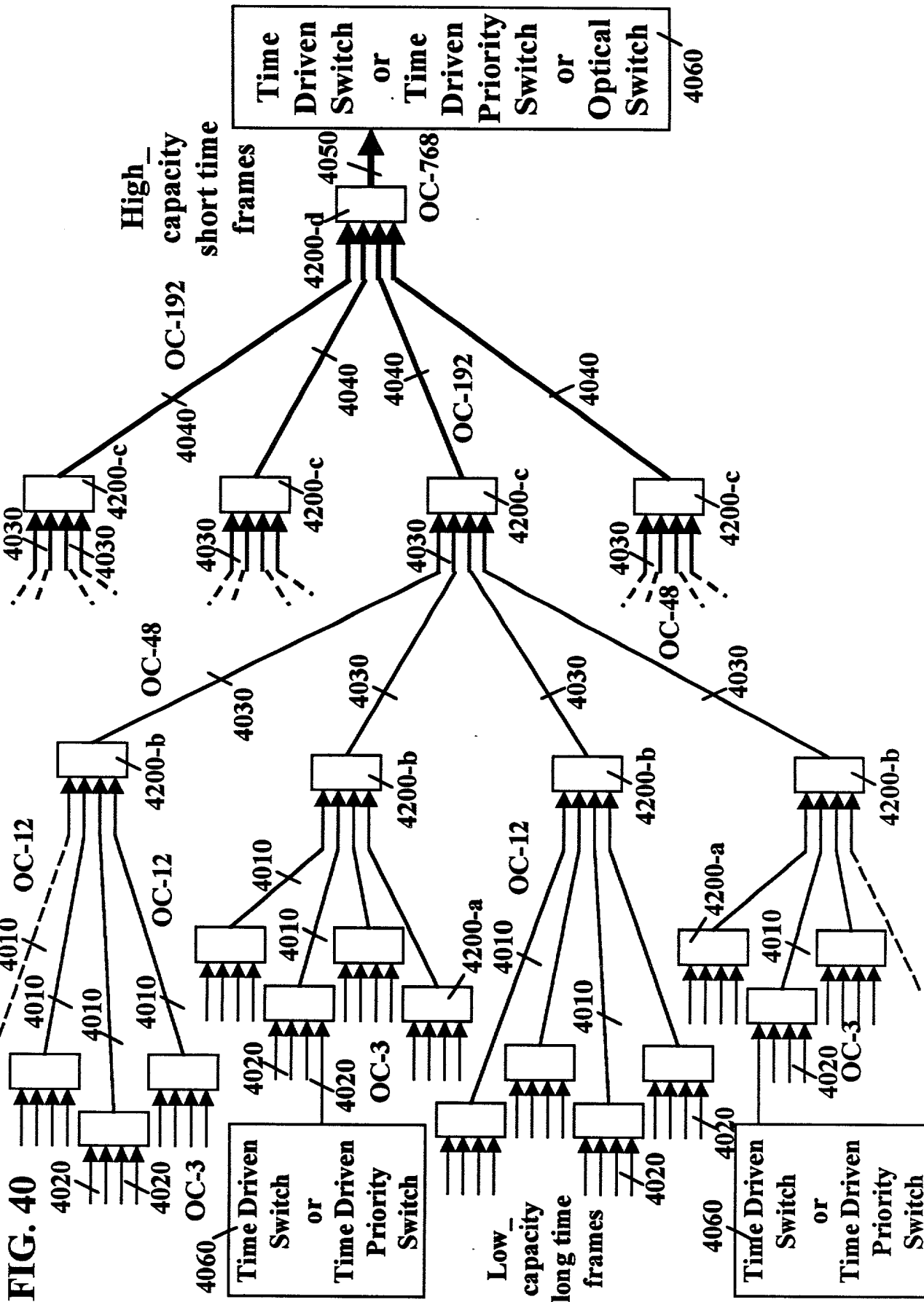


FIG. 41

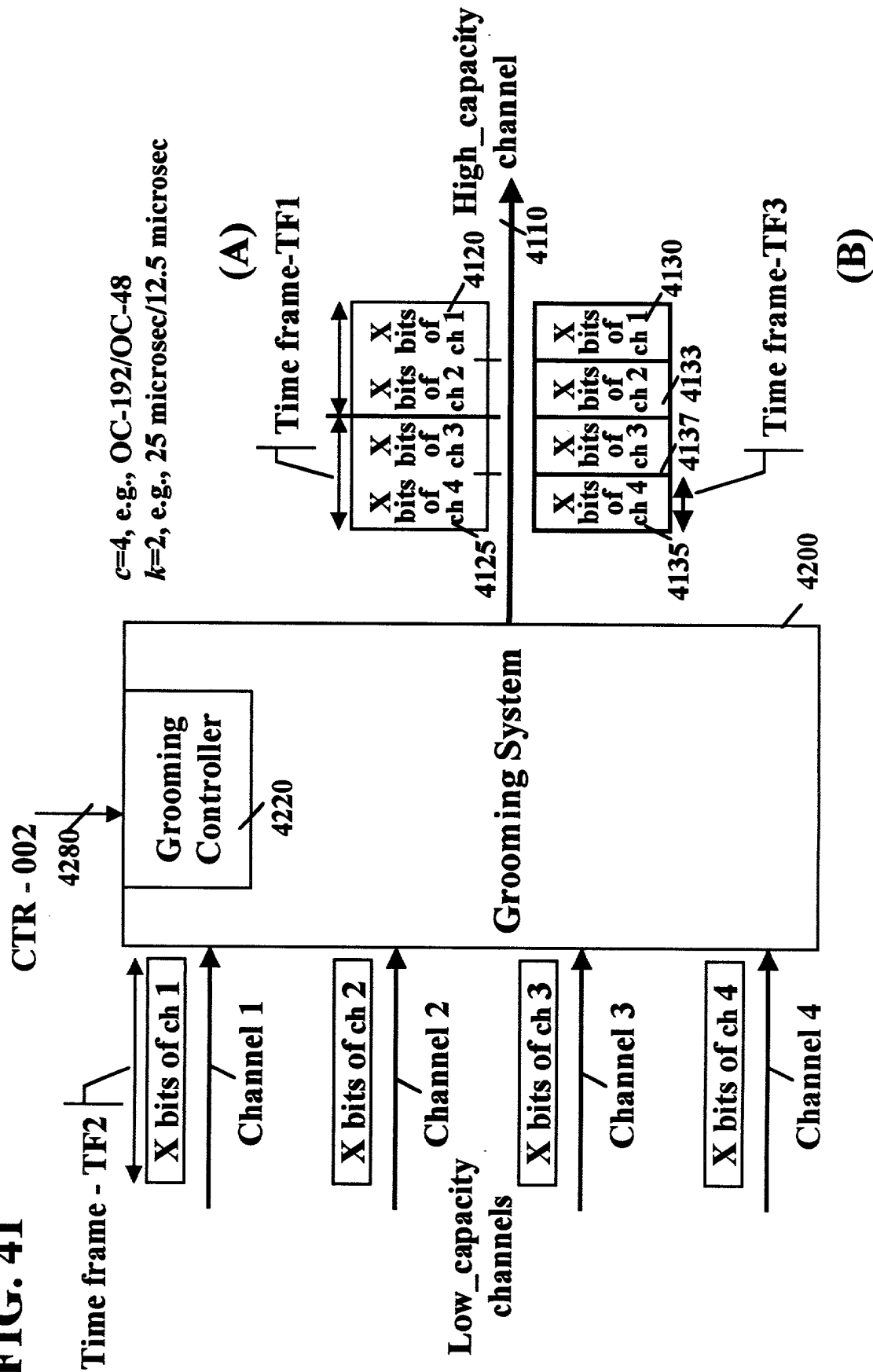


FIG. 42

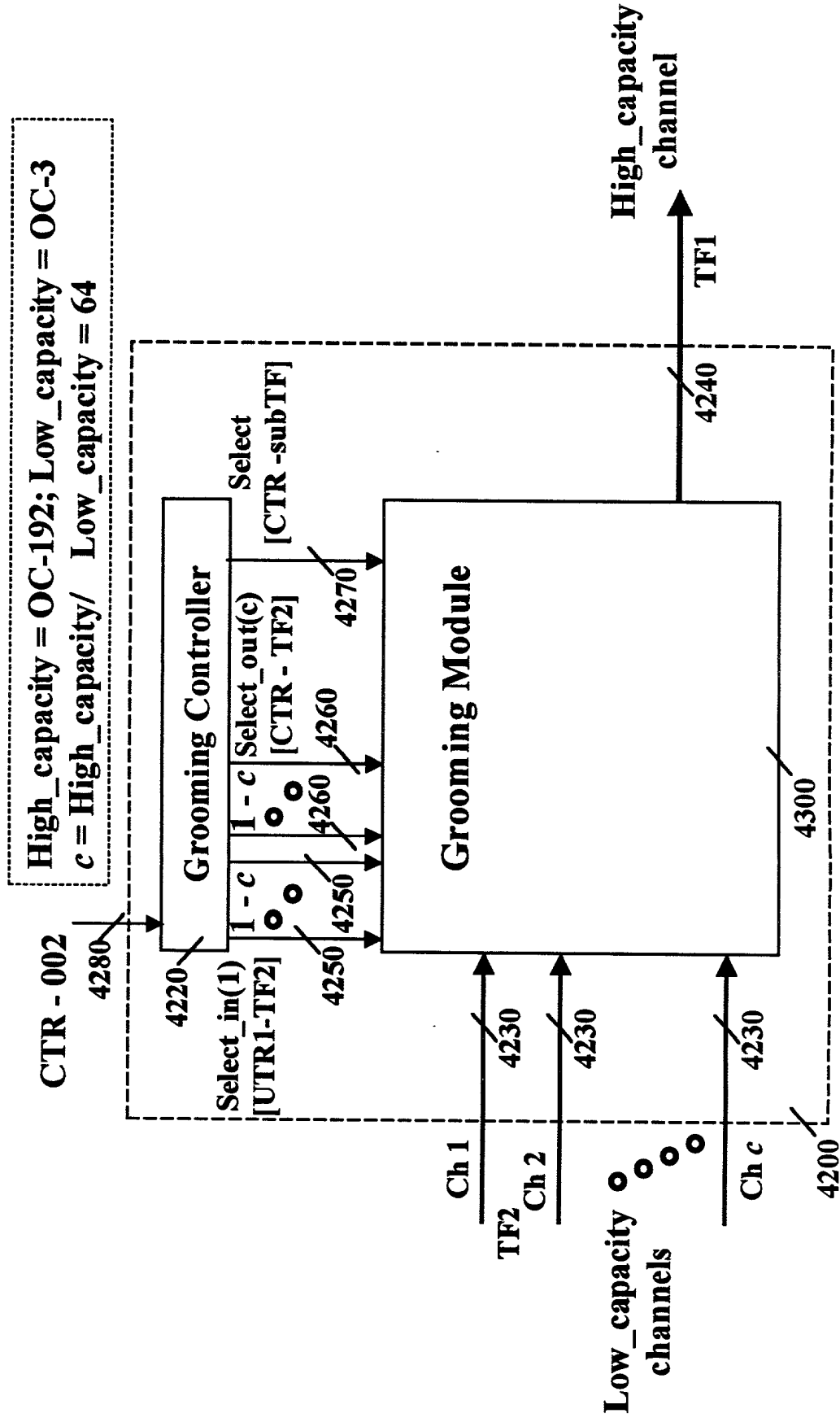


FIG. 43

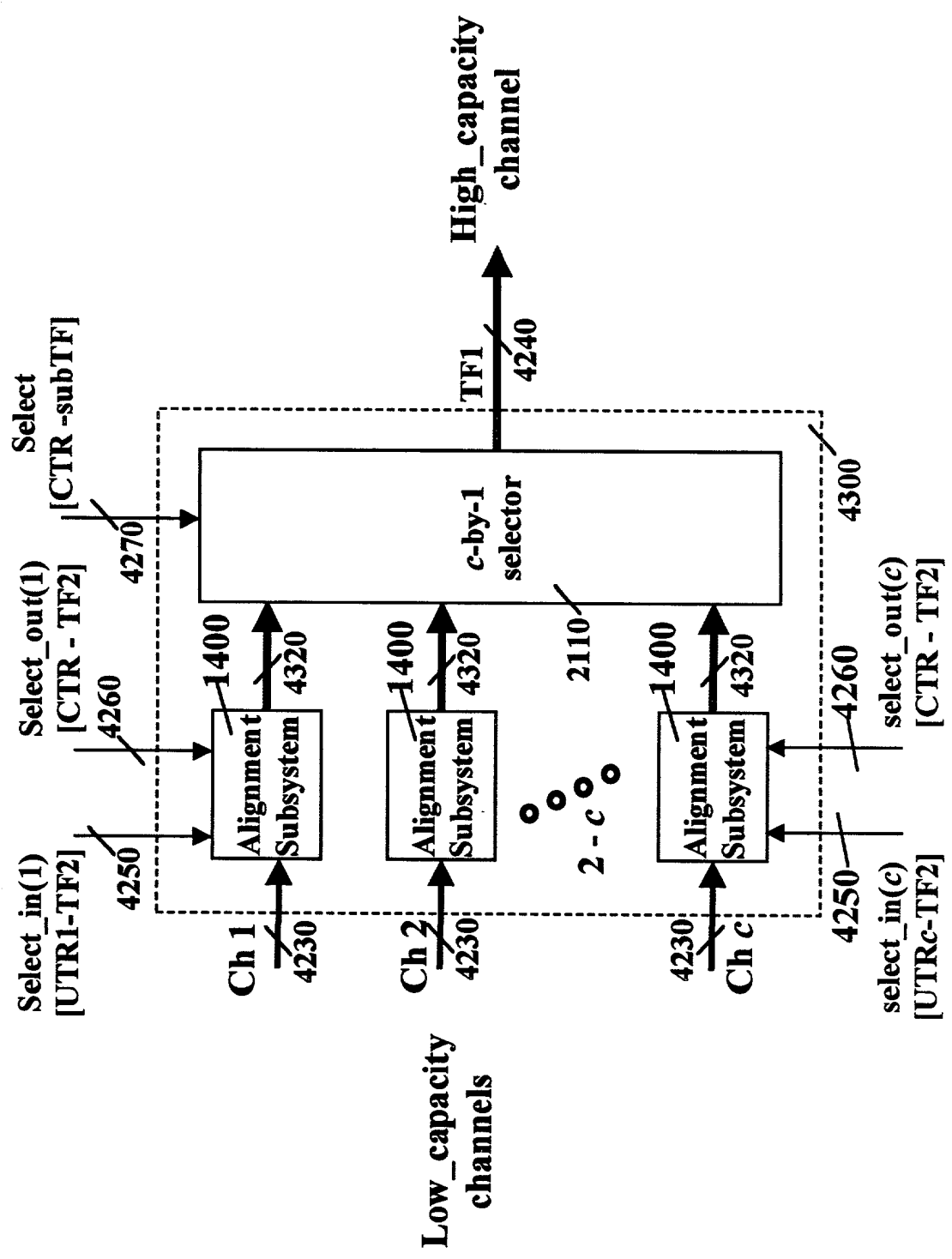


FIG. 44

- $CC1_length \cdot TF1 = CC2_length \cdot TF2 = CC3_length \cdot TF2$
- $TF2 = (SC1_length / SC2_length) \cdot TF1 = k \cdot TF1$, where the common cycles of $TF1$ and $TF2$ are aligned with respect to UTC.

For $k = 2$ and $c = 4$ (e.g., High_capacity=OC-192, Low_capacity=OC-48):

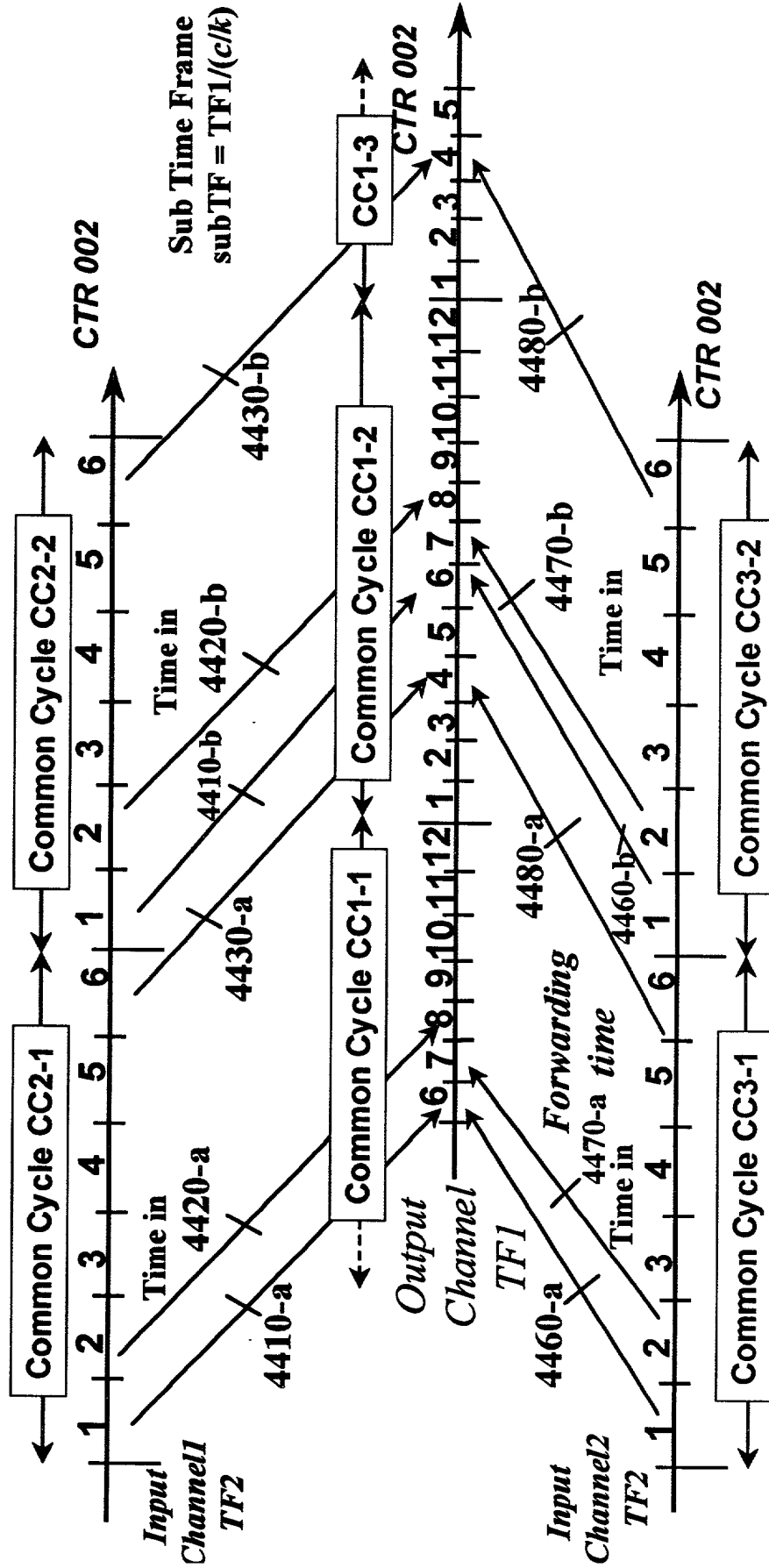


FIG. 45

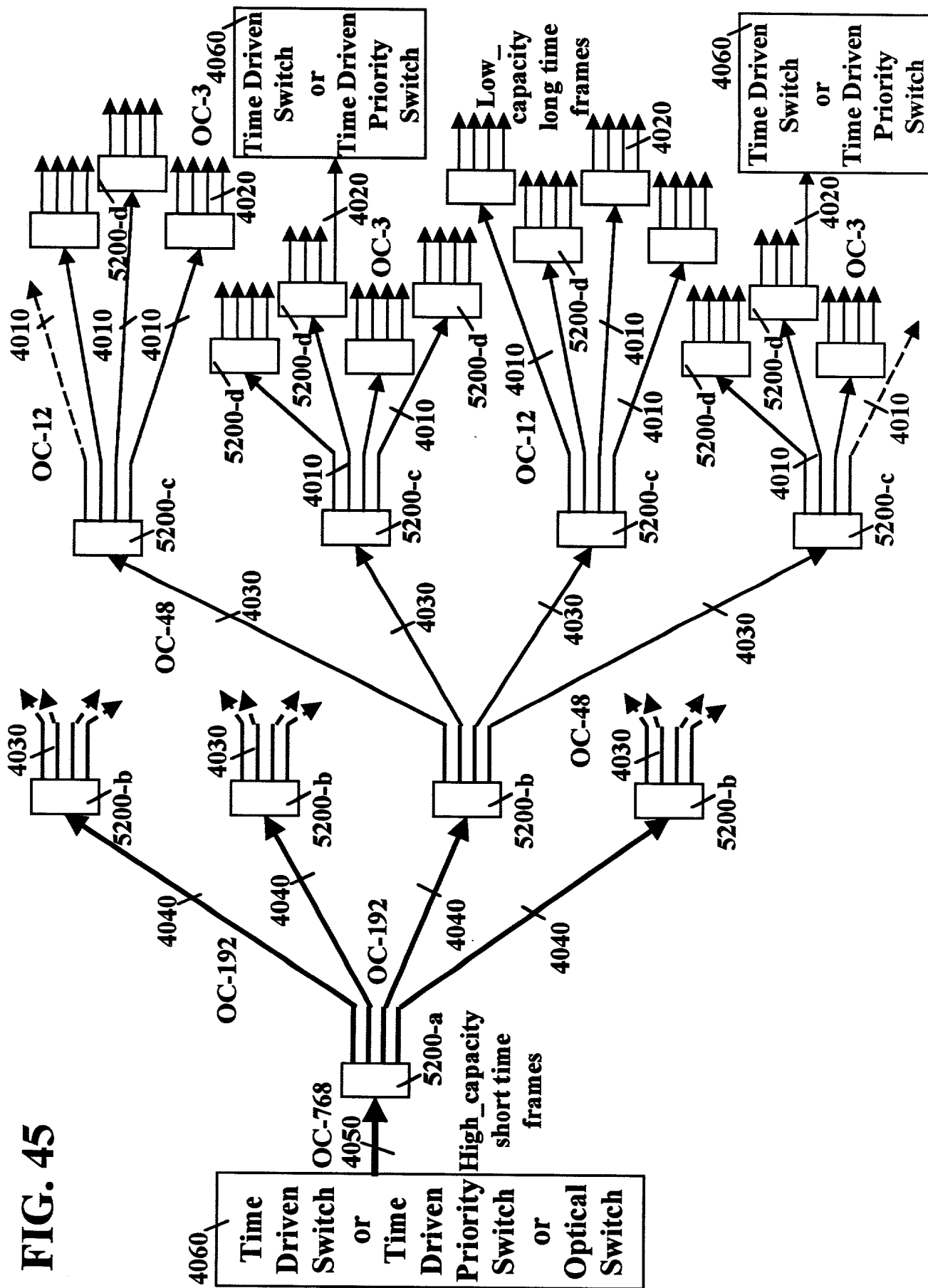
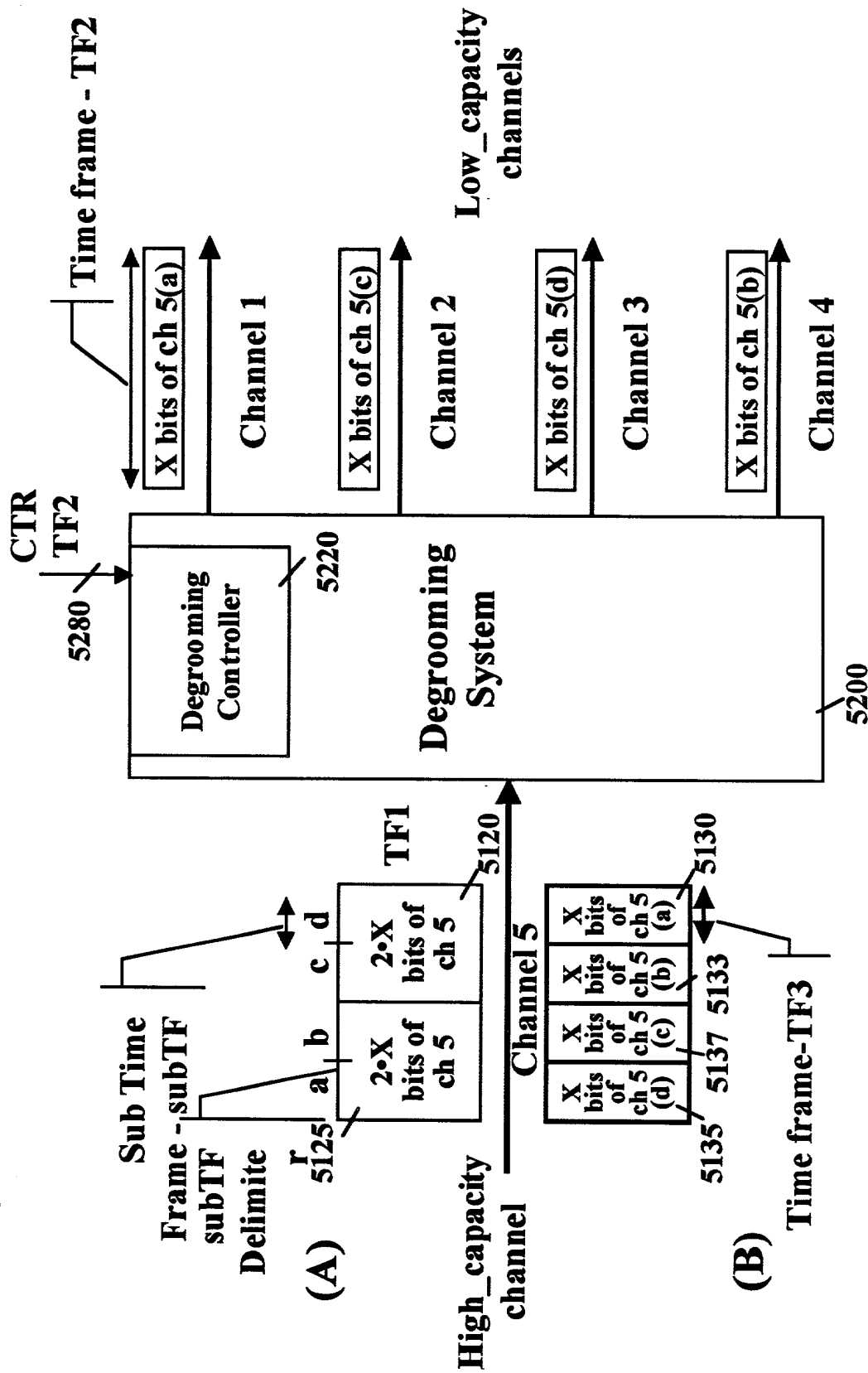


FIG. 46



c=4, e.g., OC-192/OC-48
k=2, e.g., 25 microsec/12.5 microsec

FIG. 47

High_capacity = OC-192
 Low_capacity = OC-3
 $c = \text{High_capacity} / \text{Low_capacity} = 64$

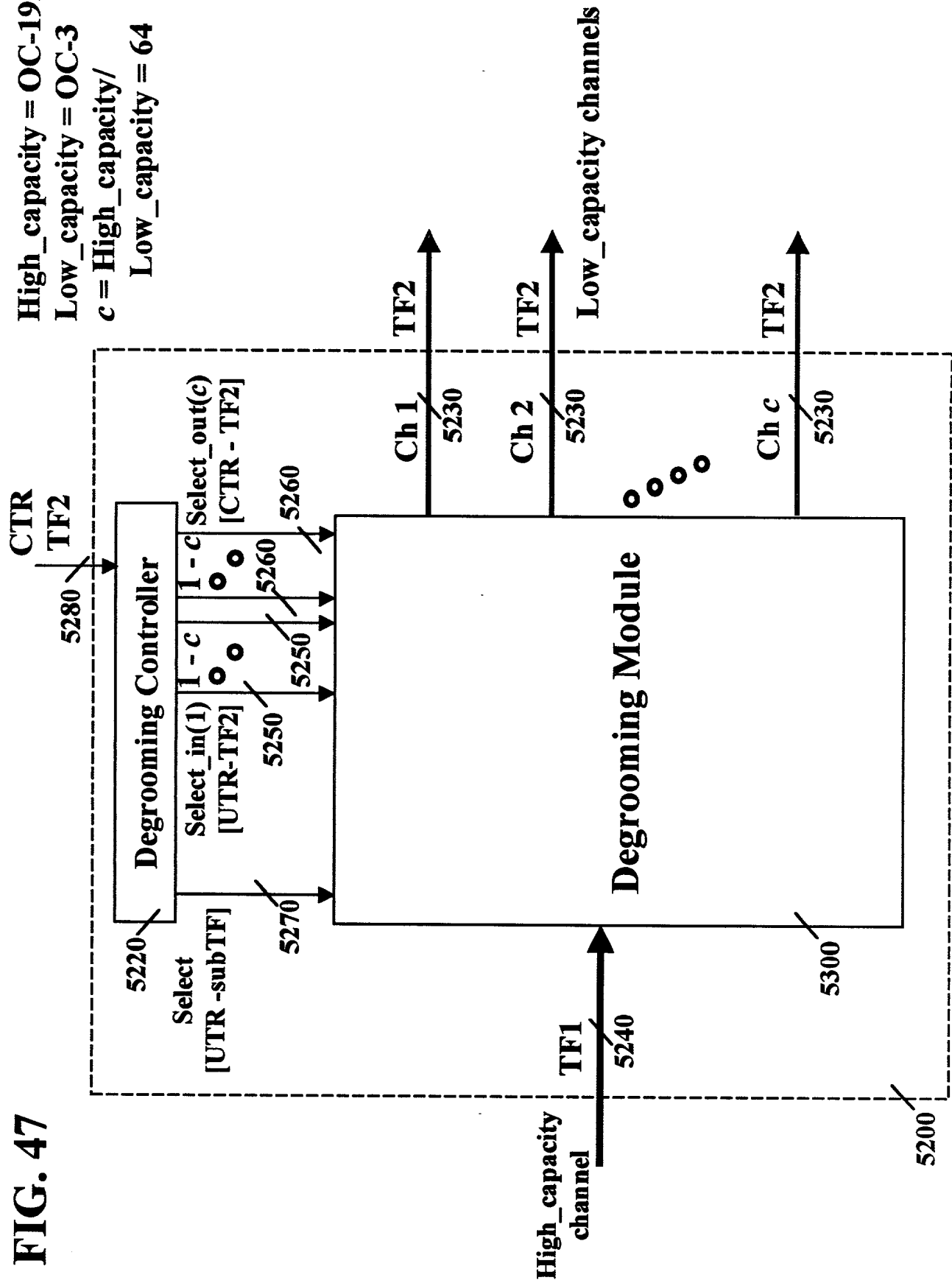


FIG. 49

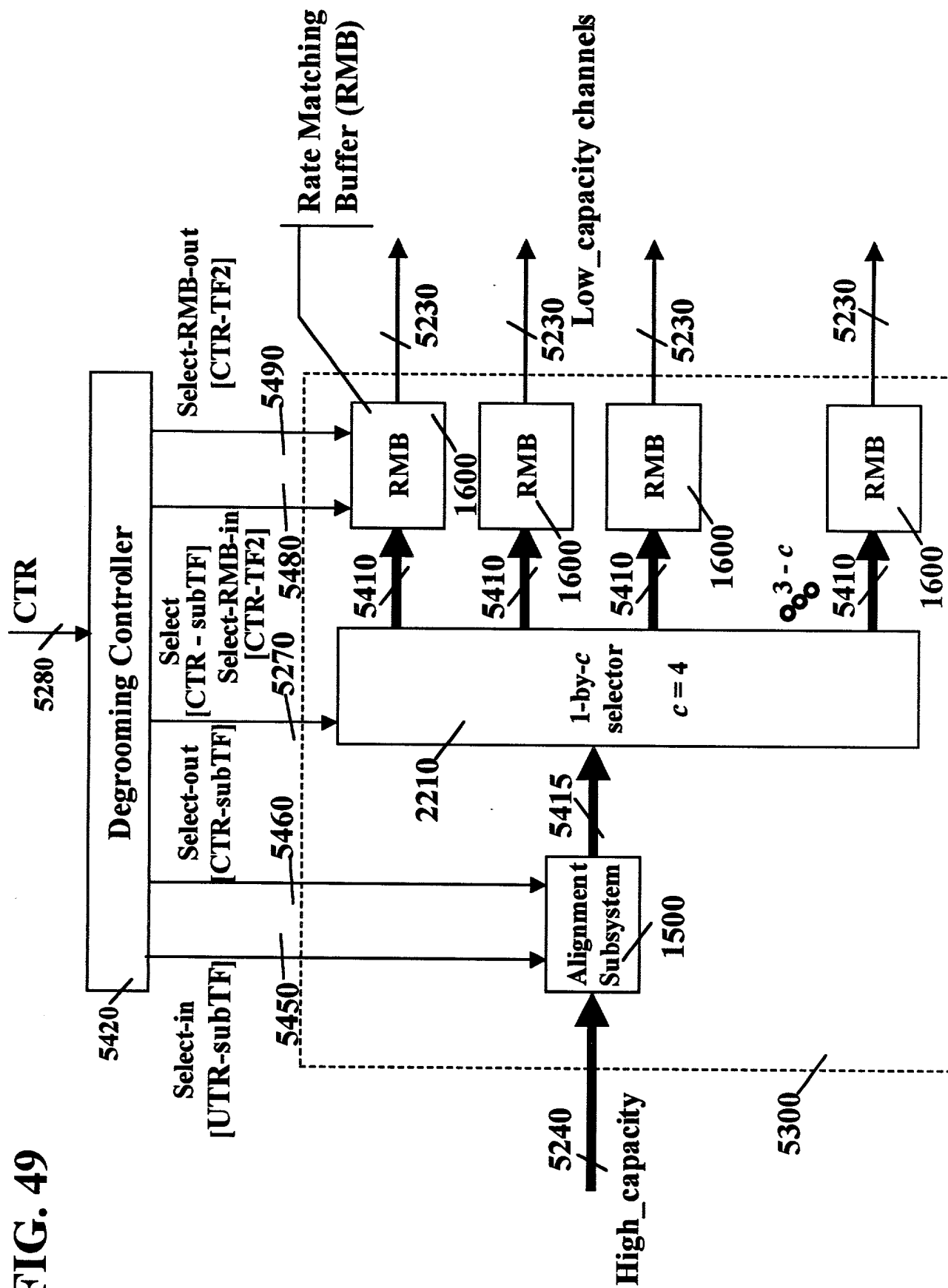


FIG. 50

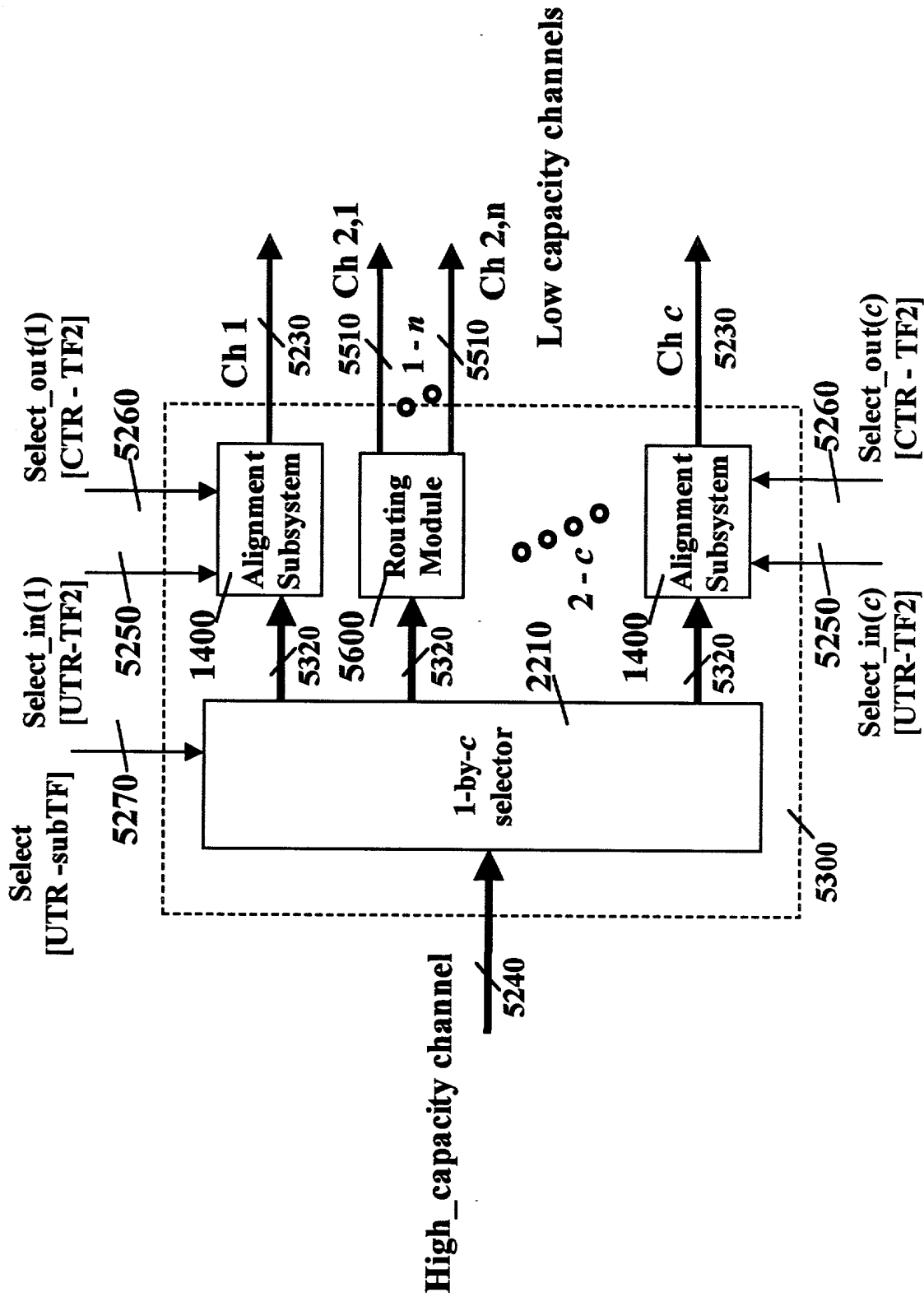


FIG. 51

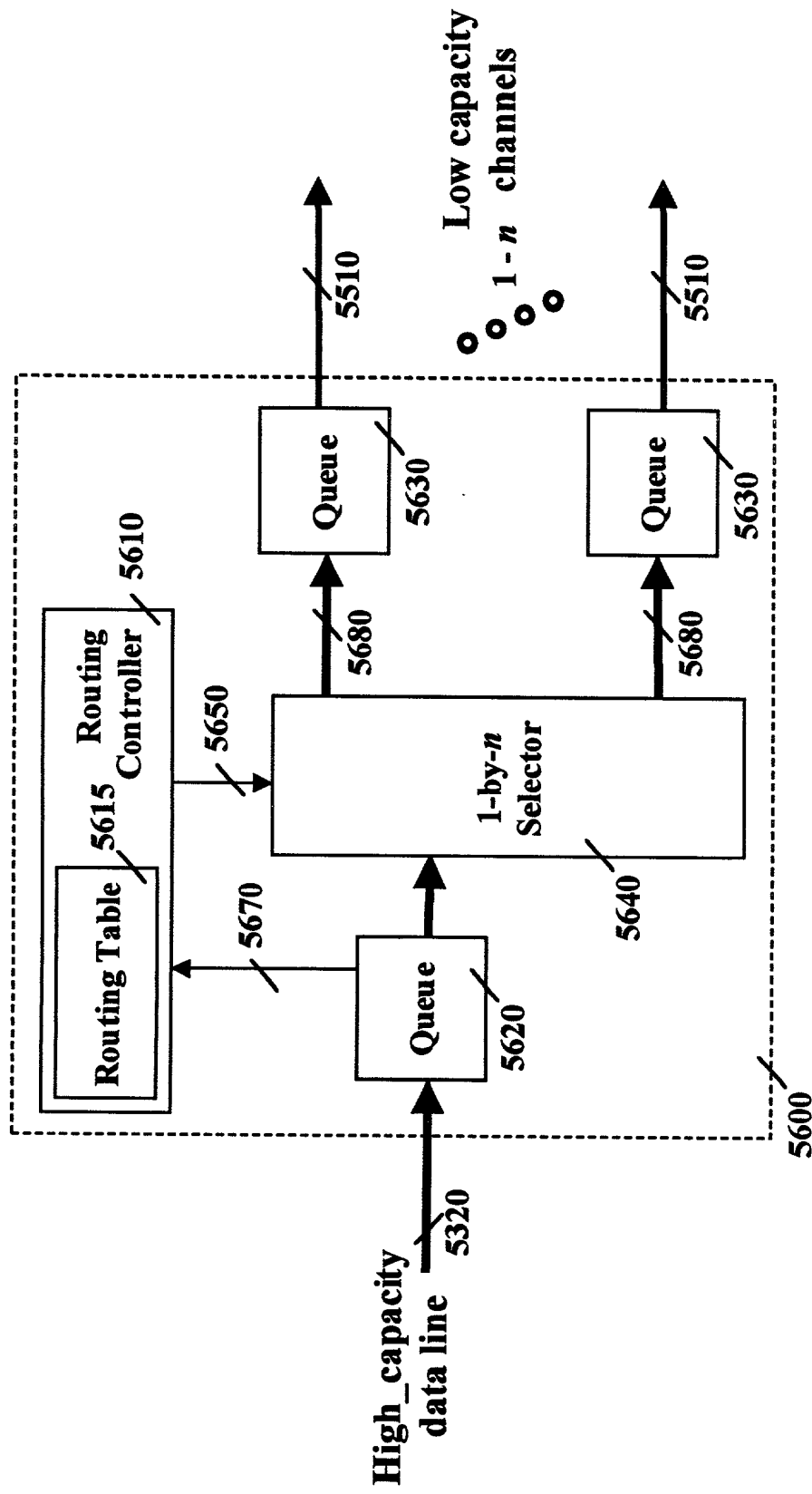


FIG. 52

- $CC1_length \cdot TF1 = CC2_length \cdot TF2 = CC3_length \cdot TF2$
 - $TF2 = (SC1_length / SC2_length) \cdot TF1 = k \cdot TF1$, where the common cycles of $TF1$ and $TF2$ are aligned with respect to UTC.
- For $k = 2$ and $c = 4$ (e.g., High_capacity=OC-192, Low_capacity=OC-48):

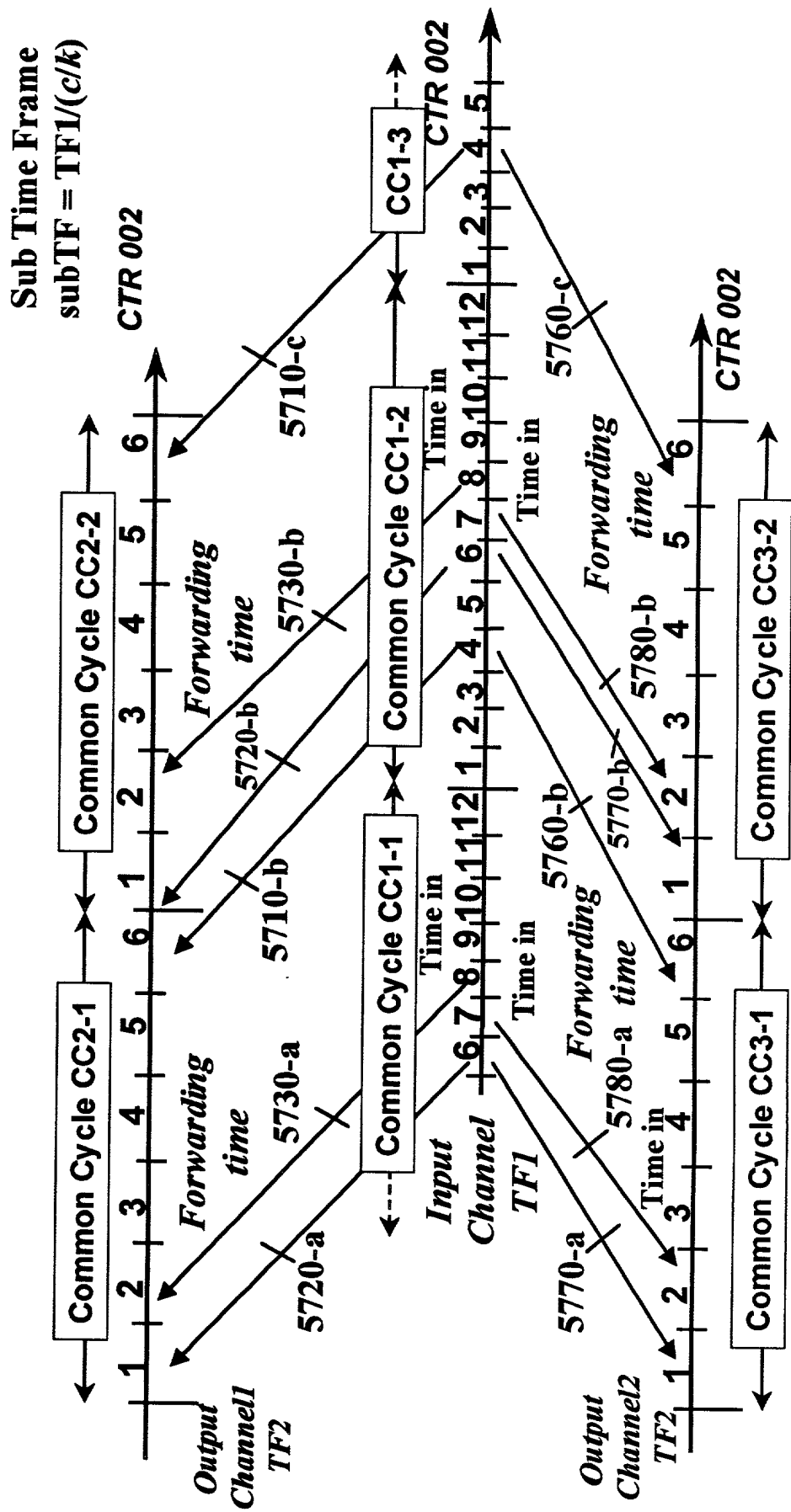
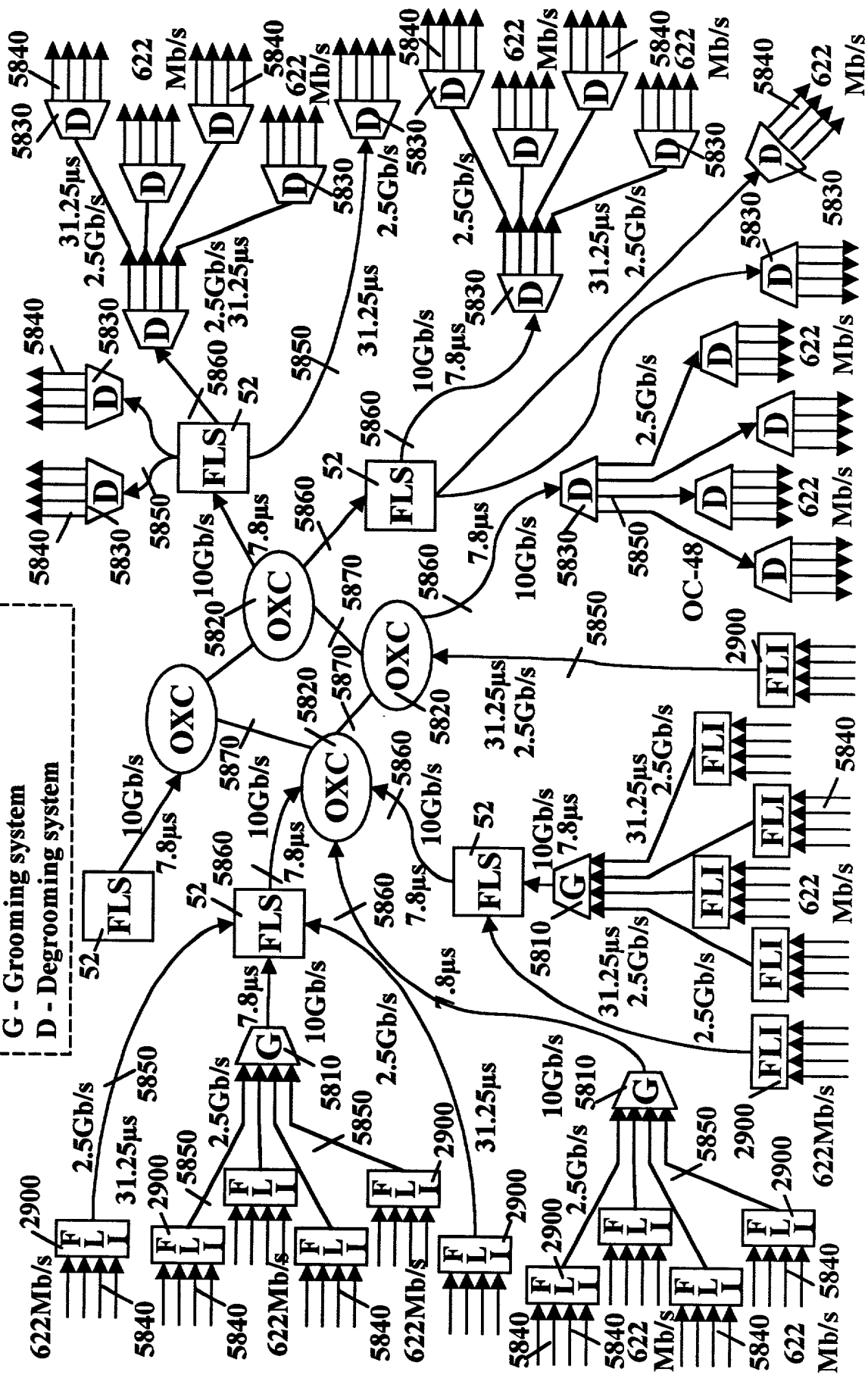


FIG. 53

FLI - Fractional Lambda Interface
 FLS - Fractional Lambda Switch
 OXC - Optical Cross Connect
 G - Grooming system
 D - Degrooming system

Time Frame size 9720 KB



12 STS-1s per time frame

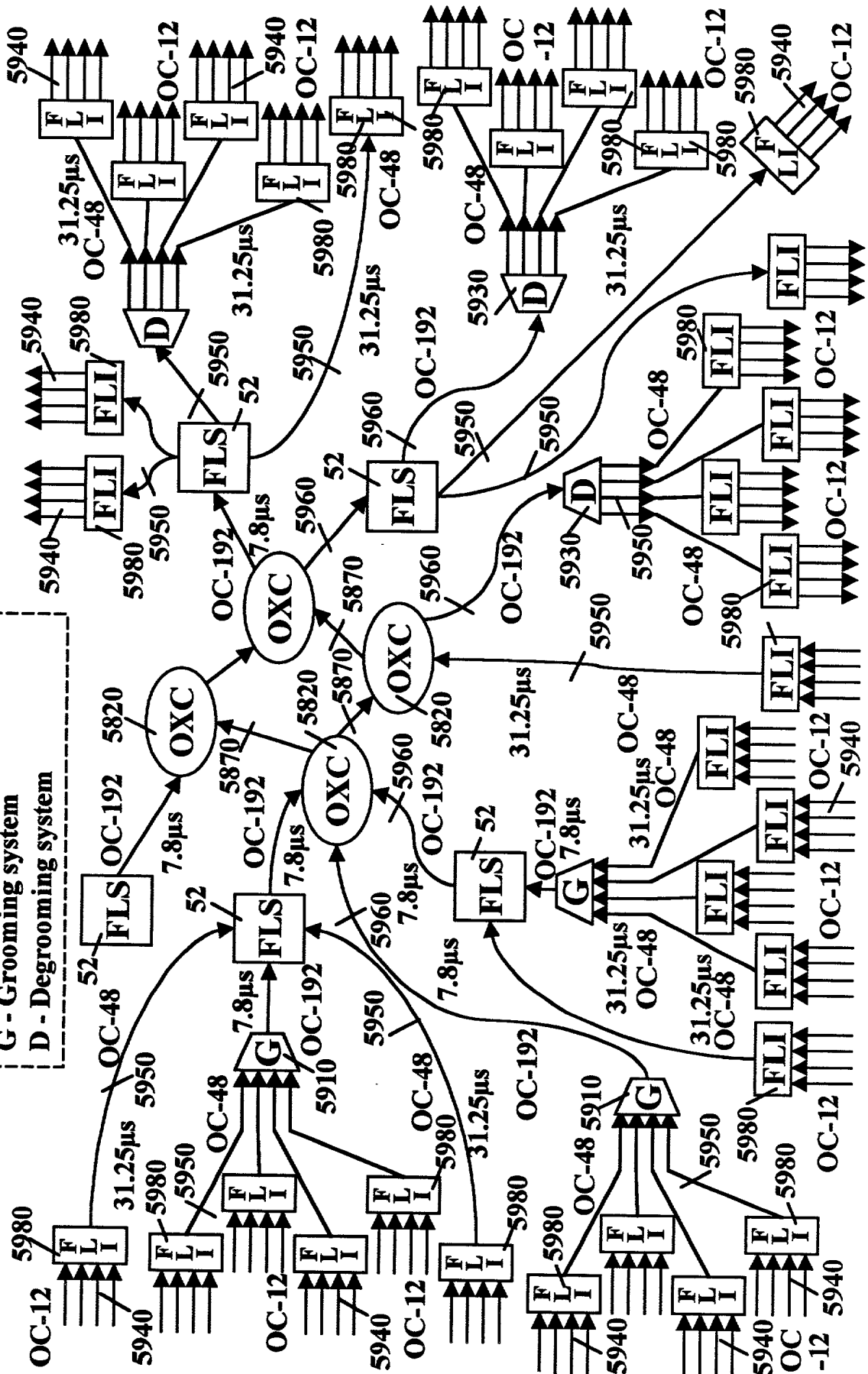


FIG. 55

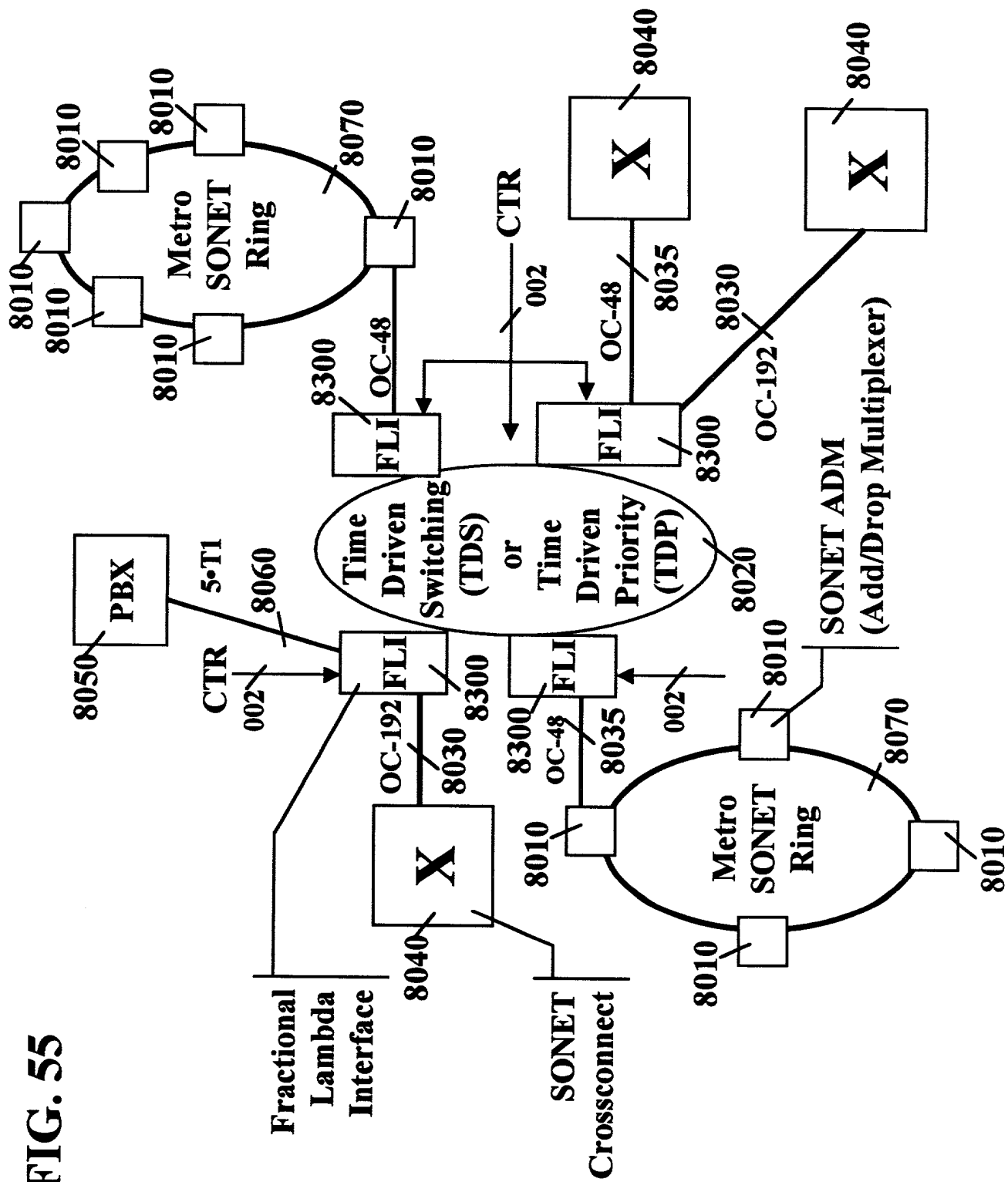
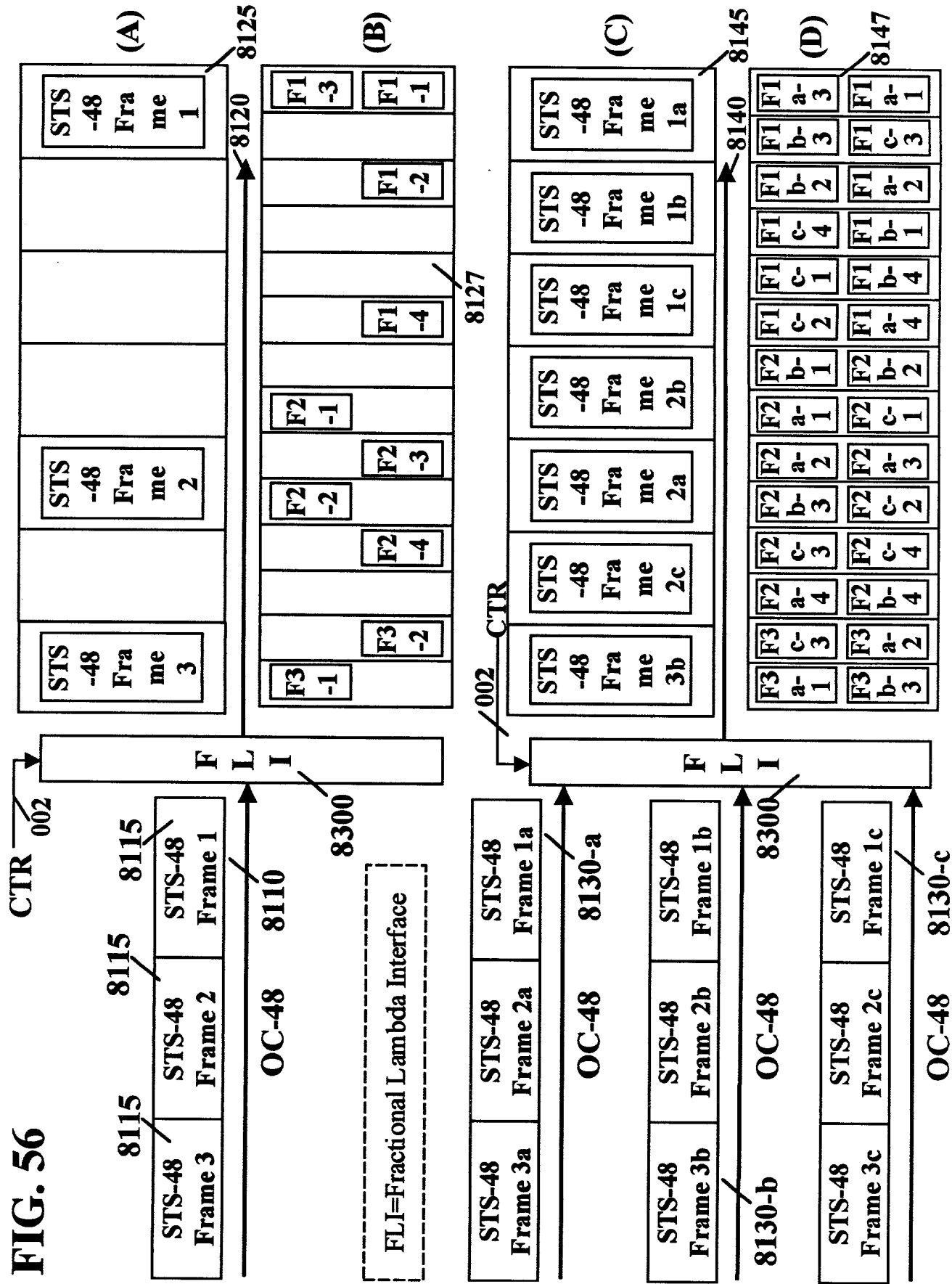


FIG. 56



CTR
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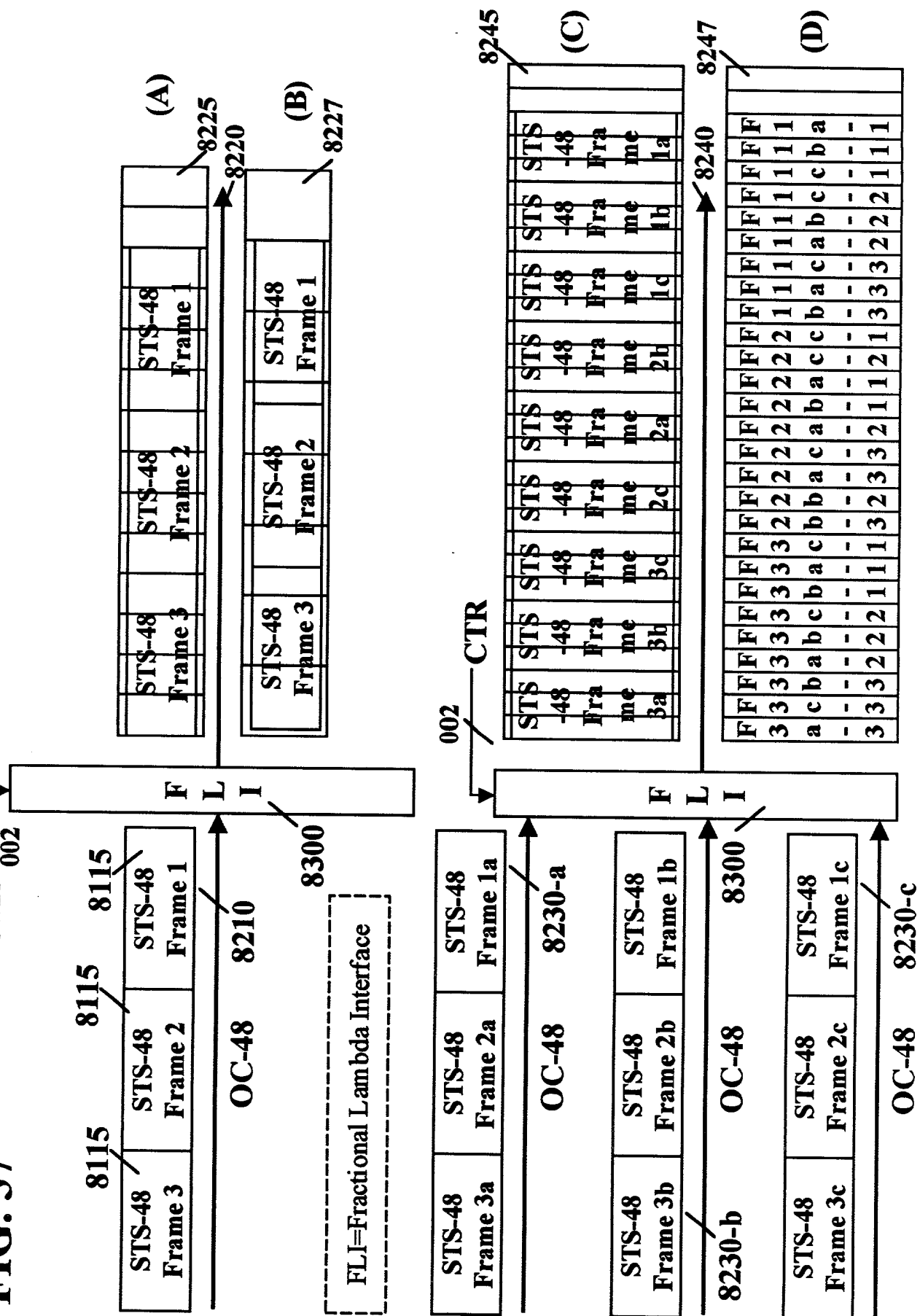


FIG. 58

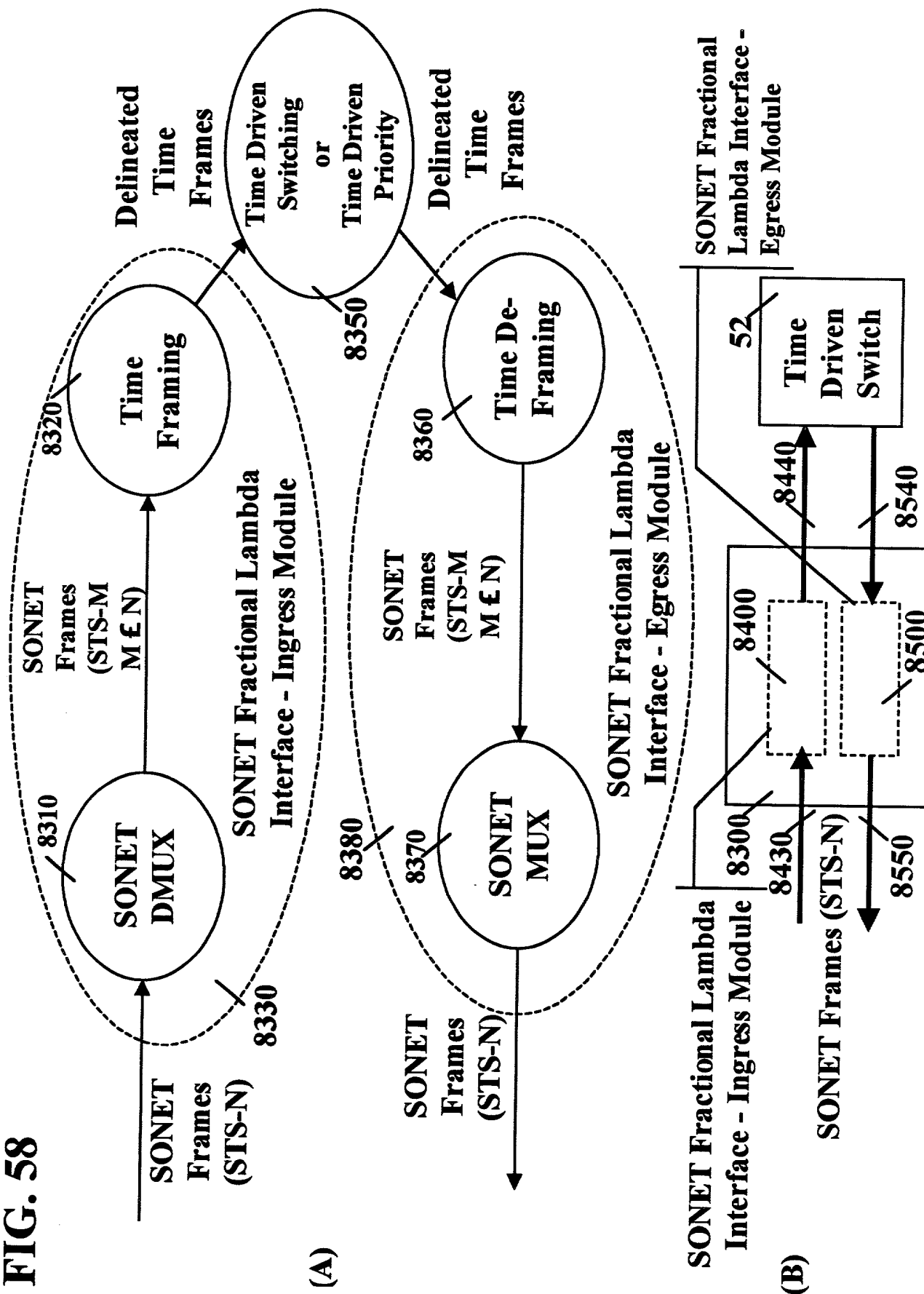


FIG. 59

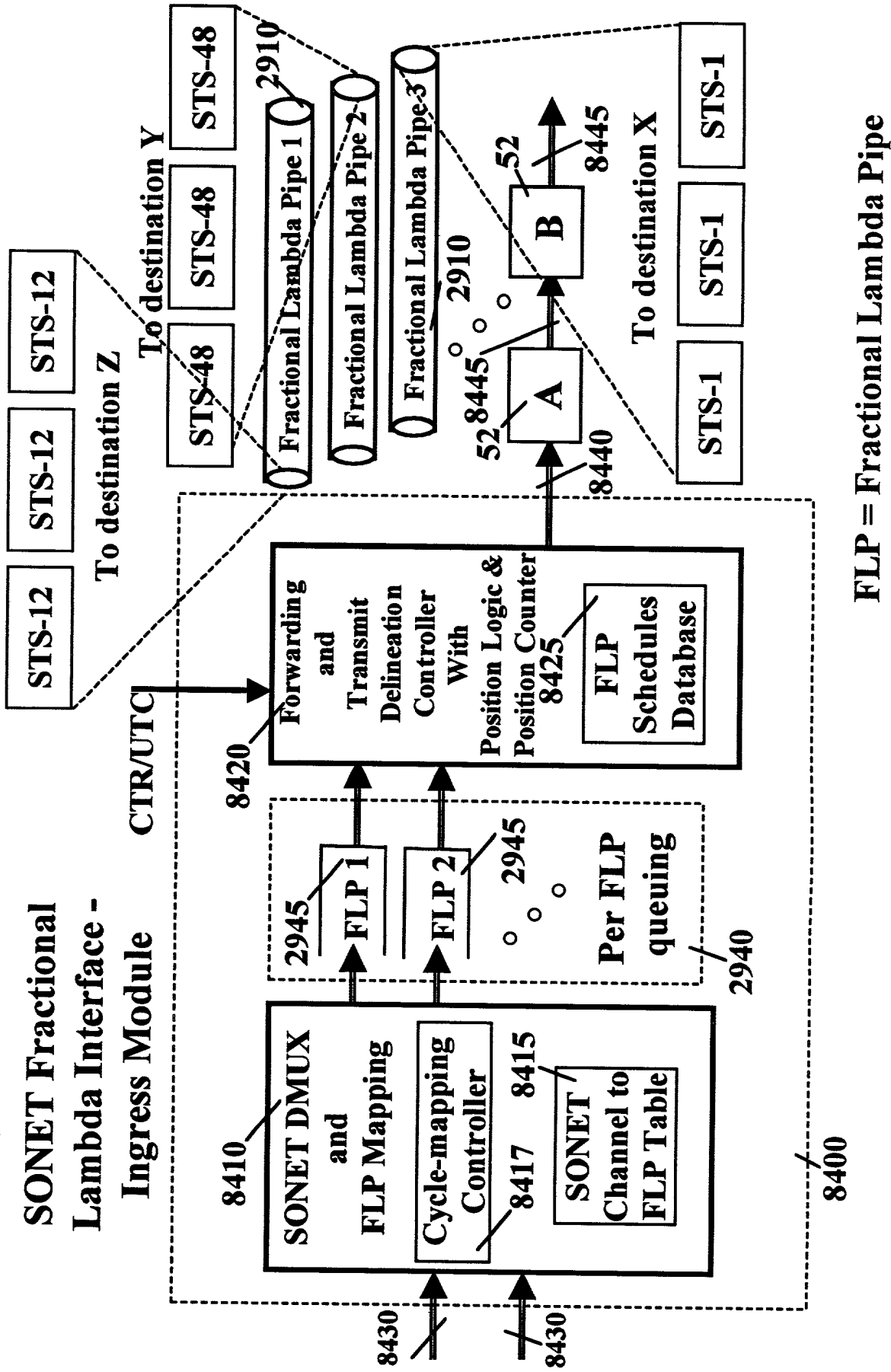
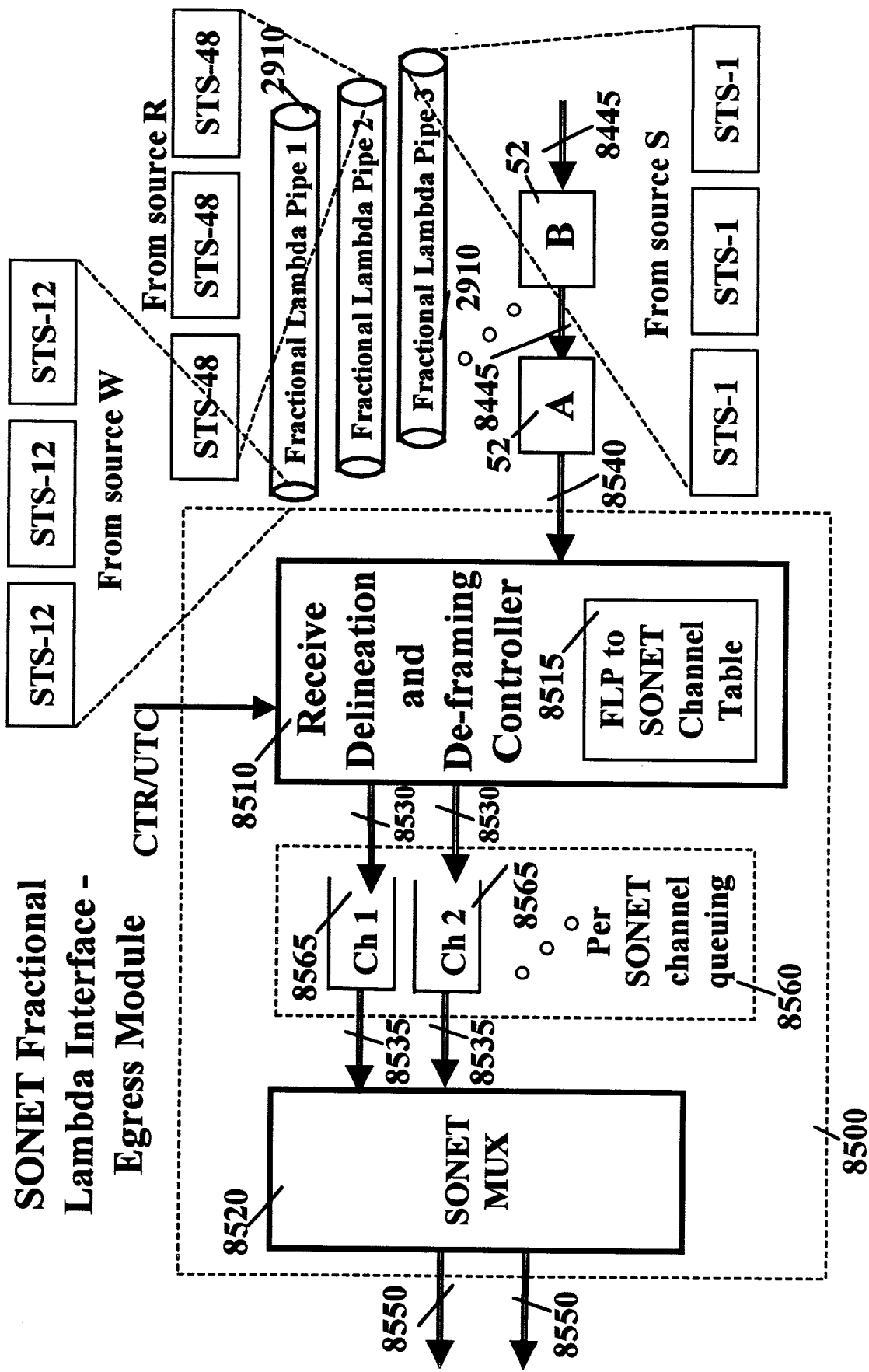


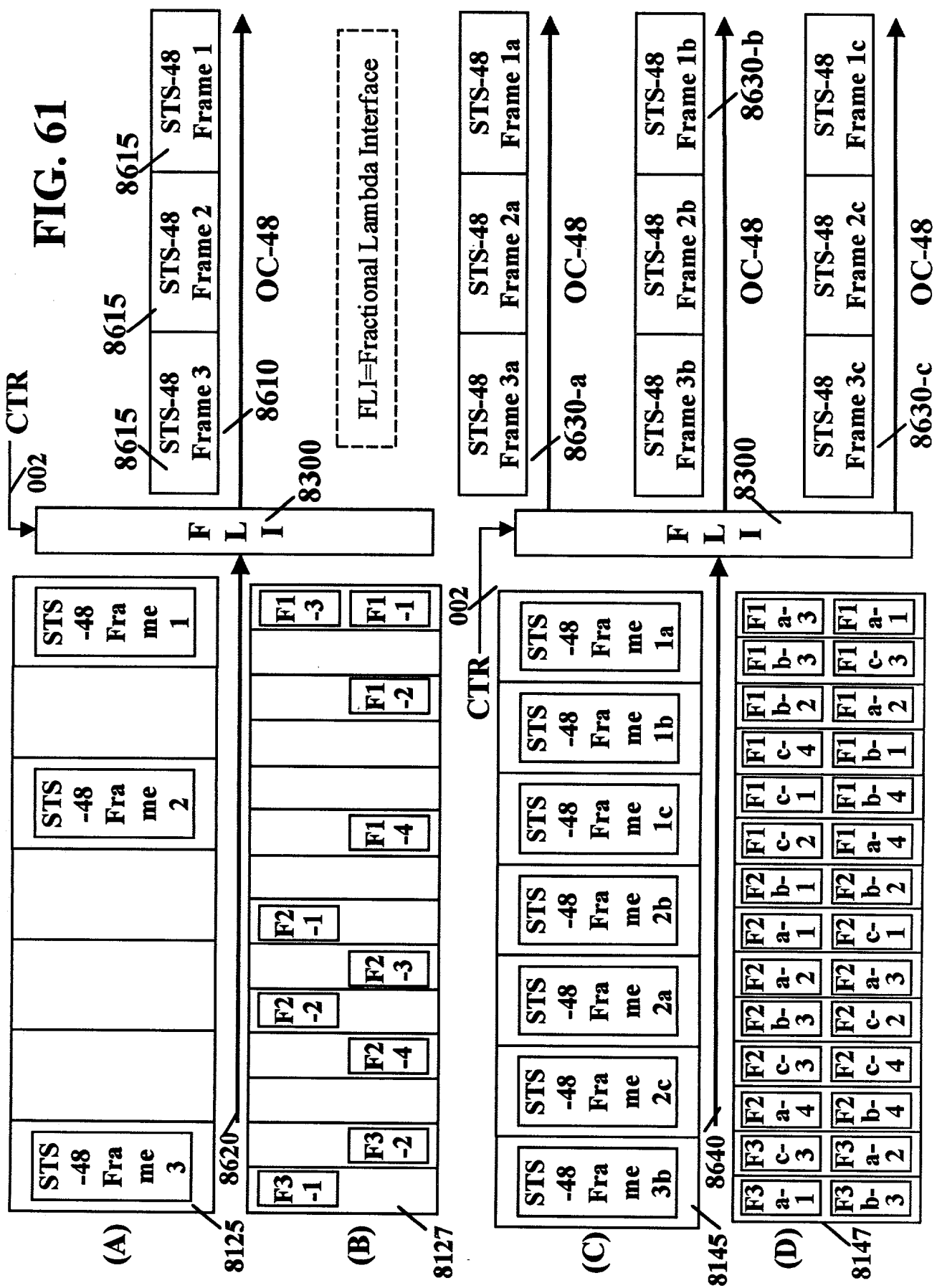
FIG. 60

SONET Fractional
 Lambda Interface -
 Egress Module



FLP = Fractional Lambda Pipe

FIG. 61



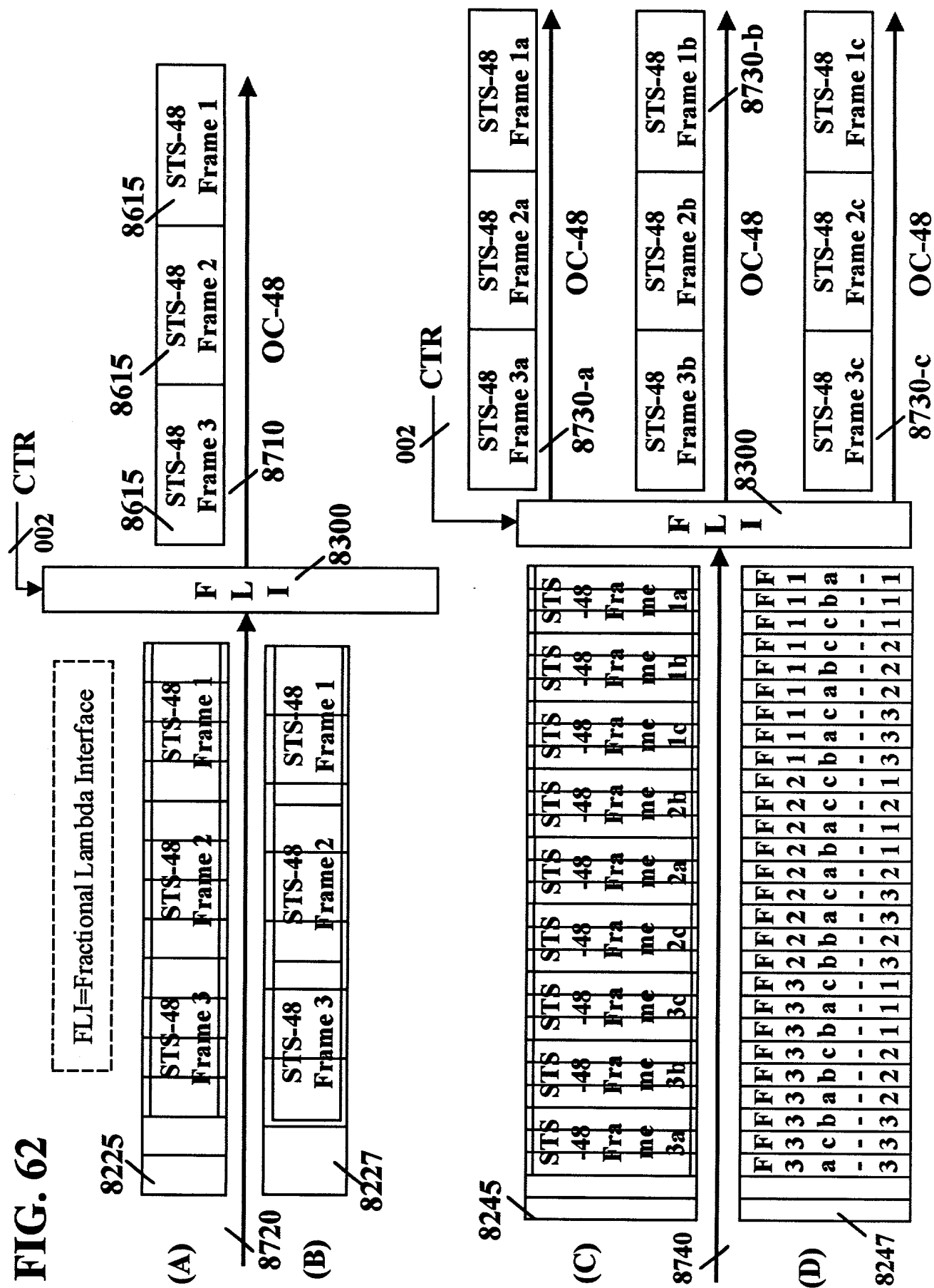
[illegible]

FIG. 63

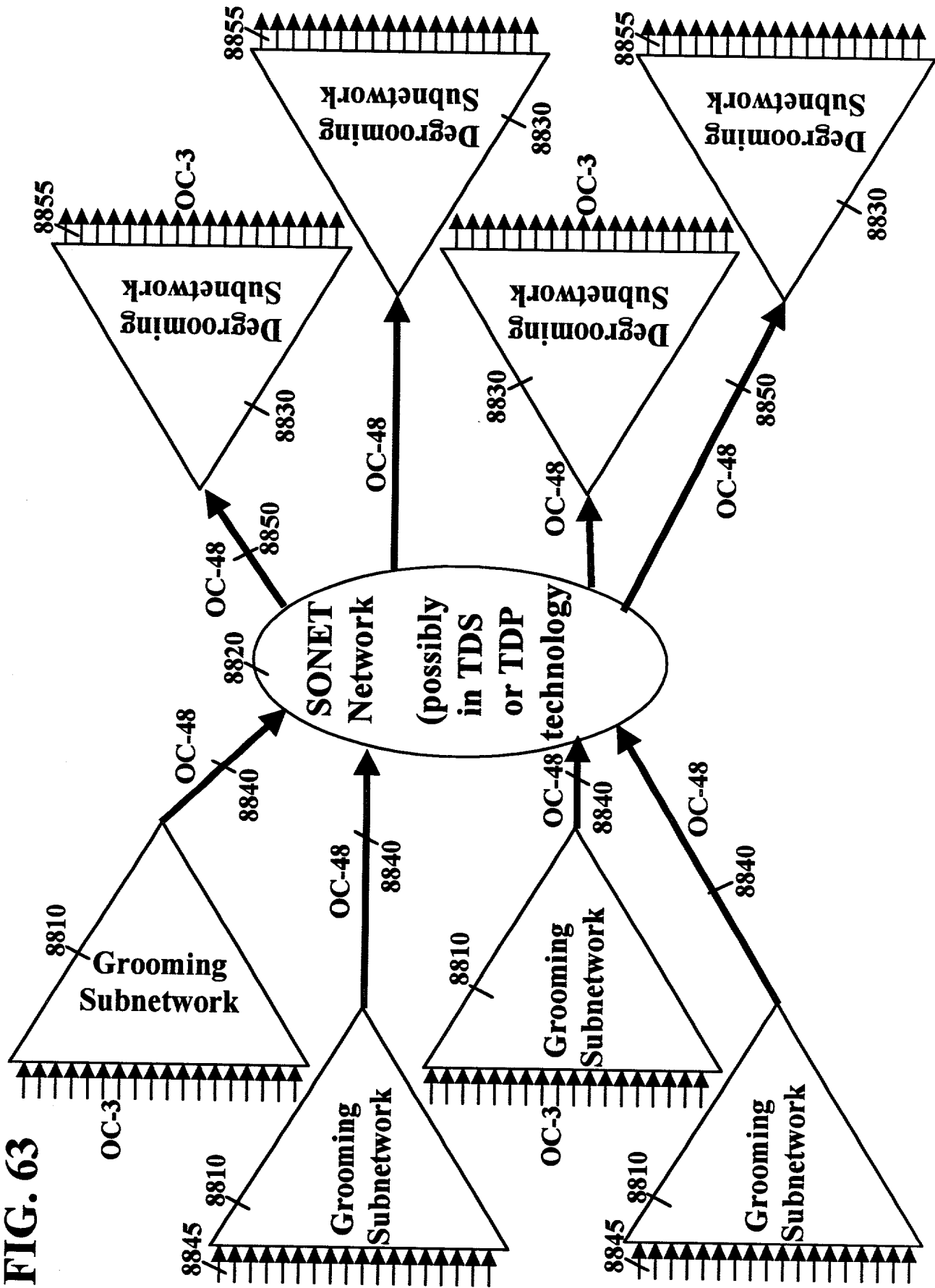


FIG. 64

- SONET - synchronous optical network
- Multiplexing method: byte interleaving
- Signal hierarchy: OC-N (STS-N)
 - STS-N rate: $N \times 51.84$ Mb/s
 - Frame format: 9 rows by $90 \times N$ columns
- capacity: $N \times 810$ bytes in 125 microsecond.
- overhead: $N \times 27$ bytes
- payload: $N \times 783$ bytes

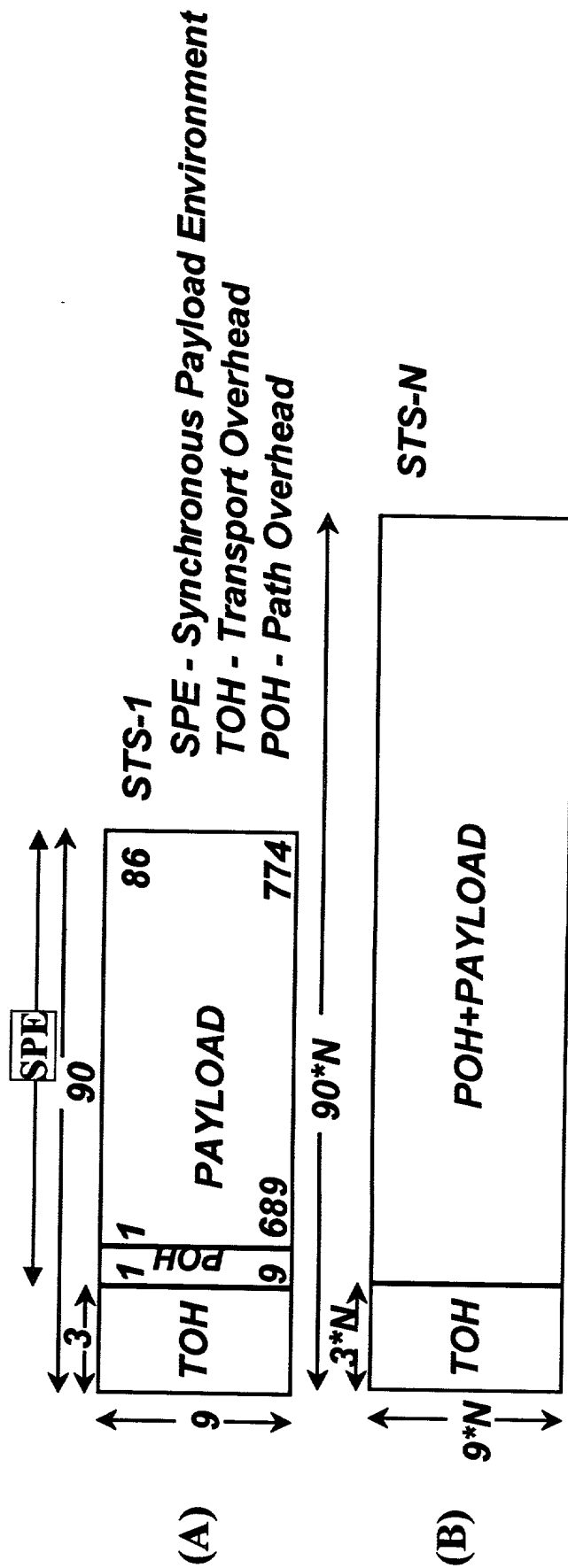


FIG. 65

